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RISK MANAGEMENT

FEATURES

DEPARTMENTS

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On the cover: The Coast Guard's HH-65A helicopter. Photo by PA2 Robin Ressler.

Assistant Commandant's Perspective

By RADM Robert C. North
Assistant Commandant For Marine Safety & Environmental Protection

Meeting the Challenges through a Risk-Based Approach

In order to meet the challenges of today and tomorrow, we need to continue improving the way we assess program needs and allocate resources. One powerful tool for doing this is the use of risk-based approaches. In recognition of this, the Marine Safety and Environmental Protection Directorate (G-M) has identified risk-based decision-making as a core competency for achieving "M" Business Plan Goals. To develop this core competency, I have had a group of my senior staff develop a capability goal to be added to our Business Plan. The end goal for this initiative is to achieve a culture in which a risk-based approach is used to aid decision-making and planning throughout the Coast Guard.

Developing and implementing risk-based decision-making will provide for a better understanding of the maritime system, and thus help us make better decisions in our role as the nation's maritime regulatory agency. These risk-based approaches will allow for an optimal use of existing resources, maximizing return on the taxpayers' investment. It will also provide for a more defensible budget with an ability to translate funding needs into expected decreases in fatalities, injuries, and pollution. Finally, the forward-looking techniques of risk-based decision-making will allow us to identify and address emerging trends that affect safety.

G-M has used risk-based approaches successfully in the past, such as in the process used in selecting sites for installing Vessel Traffic Services and carrying out the Port State Control Program. A significant milestone has been the successful implementation of the Risk-Based Decision-Making Guidelines, which were distributed in 1997. (An upgraded version will be distributed in the near future.) Using the guidelines as a basis, field units have successfully employed risk-based decision-making to resolve many issues. The capability goal will align individual unit efforts and previously unconnected risk-based activities into one connected, holistic approach. Risk-based decision-making provides an outstanding opportunity to make significant improvements in program effectiveness. I encourage all involved in the maritime industry to consider this powerful approach to management, and I look forward to hearing your success stories.

Editor's Point of View

By Edward Hardin

Proceedings, as always, strives to keep you informed about all aspects of the maritime industry.

Risk

The theme of this issue is indeed timely. We have had several personnel changes in the publications department during the last year. This issue was definitely a risk. Not only were we going to use a new Graphic Designer, we were also going from rough draft to final publication faster than any other *Proceedings* in recent history.

It is my honor and pleasure to introduce our subscribers to Jason Peak. Jason has recently joined the publication staff here at the National Maritime Center. Many of you who subscribe to our *Marine Safety Newsletter* have been privileged to preview Jason's work with the total redesign of the newsletter.

Going into the millennium is exciting; going with Jason is awesome. I am certain that changes to the *Proceedings* will be welcome. We would like to ask, what can we do for you? Please help us to continue producing a publication that meets your needs and expectations.

I am extremely proud of our publication staff and look forward to the risk and opportunities the new millennium brings.

A special thank you to all our readers!

Correction: We neglected to credit the author of "The Merchant Mariner, His Credential Renewal and His Health" in the last issue. It was written by Betty A. Garner, Marine Transportation Specialist (Documents) Medical Waivers, National Maritime Center.

Next Issue:
WATERWAYS MANAGEMENT

The Road Ahead

By CAPT Mark VanHaverbeke,
Chief, Office of Design and Engineering Standards,
and
CDR Timothy Close,
Chief, Human Element and Ship Design Division

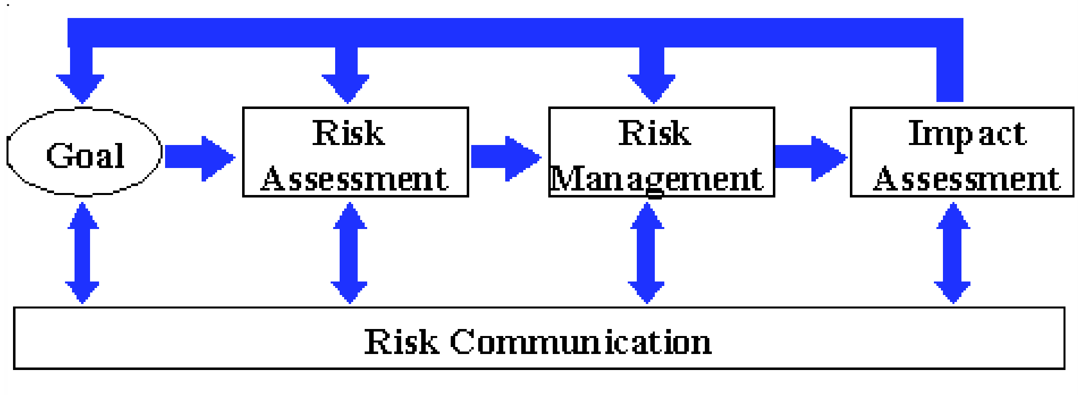
Teddy Roosevelt, former President of the United States, once said of wild cows, "…that to race a cow two miles at full speed on horseback, then rope her, throw her, and turn her upside down to milk her, while exhilarating as a pastime, was not productive of results." While the quote is a far-fetched analogy for risk, perhaps, it is still an appropriate image. All of us at one time have been drawn into a highly visible and exhilarating activity that was not very productive. Risk-based decision-making is about making productive choices and focusing on the activities that are most productive of results. As is noted in the Marine Safety and Environmental Protection Directorate (G-M) Performance Plan, "Risk management is our business." Indeed, the concept of risk (defined as the combination of the consequence of a hazard or mishap and the likelihood that it will happen) can be seen to encompass all Coast Guard missions and activities, which can be roughly divided into prevention activities and response activities. From Search and Rescue to marine inspection, drug interdiction and pollution response, all Coast Guard missions are geared toward reducing the likelihood of some undesirable event or accident (prevention), to mitigating the consequences should it occur (response), or both.

While the Coast Guard has always used some of the basic concepts of a risk-based approach, there has been a significant push of late to expand capabilities in this area, particularly within the G-M program. Considerable effort is being brought to bear to develop risk-based decision-making as a core competency. This investment is expected to bring considerable return in a number of areas. The primary benefit of a risk-based approach is the ability to optimize the use of resources to reduce risk. By identifying and evaluating the myriad of hazards to which the Coast Guard responds, better decisions can be made about how to use the limited resources at our disposal. When used in combination with an approach such as activity-based costing, the costs (in dollars, labor-hours) and expected benefits of various types (e.g., fewer deaths, more vessel inspections) and degrees of intervention can be compared. Then, that mix which provides the "biggest bang for the buck" can be chosen. Such an approach can be employed and benefits can be obtained at any level of the organization, from individual members to the entire Coast Guard. In today's tight budgetary environment, and with the scarcity of personnel, this management tool is critical to ensure continued success.

> *Risk-based decision making is about making productive choices and focusing on the activities that are most productive of results.*

In addition to the ability to maximize our effectiveness as an organization, the use of a risk-based approach to management will provide a number of other significant benefits. One such benefit is the more defensible budget that would result with the ability to quantify not only the value of the Coast

Figure 1.



Strategy 1: Develop foundation providing focus for and components of an integrated risk-based decision-making system	Activity 1.1: Develop Risk Doctrine Activity 1.2: Evaluate existing capabilities (methodologies, data, training) versus decision making needs Activity 1.3: Identify gaps in existing capabilities Activity 1.4: Develop Risk Strategic Plan Activity 1.5: Develop methodologies for assessing and managing risk Activity 1.6: Develop data sources to support risk assessment and risk management
Strategy 2: Deploy high-quality risk-based decision making policies and tools to support decision-makers.	Activity 2.1: Identify skills and resources necessary to use methodologies Activity 2.2: Identify current skills and resources to use methodologies Activity 2.3: Identify gap between current capabilities and needed skills Activity 2.4: Develop training or job-aids necessary to close gap Activity 2.5: Generate risk-based Business Plan, prioritizing goals based on identified risks Activity 2.6: Provide management direction to use risk
Strategy 3: Execute Risk-Based Decision Making Program to Achieve a culture in which appropriate, systematic risk-based decision-making processes are used to aid decision-makers.	Activity 3.1: Provide necessary training and job-aids to right people Activity 3.2: Provide support to units using methodologies Activity 3.3: Use risk-based approaches for making decisions Activity 3.4: Identify low risk/low value activities for change/divestiture as appropriate Activity 3.5: Communicate RBDM value and successes to stakeholders (Congress, industry, public) Activity 3.6: Export/expand to programs outside of M as appropriate Activity 3.7: Periodically re-evaluate tools and methodologies Activity 3.8: Periodically re-evaluate overall effectiveness of RBDM

Table 1. Risk Capability Goal.

Guard to the public, but also the expected increases or decreases in deaths, injuries, and pollution, given increases or decreases in the Coast Guard budget. Another benefit is the ability to defend decisions made through use of a logical process, be it to senior management, political representatives, the public, or the media. Although use of a risk-based approach cannot guarantee success in a particular application, over the long haul it should result in an increased level of success. Examples of some of the successes already achieved by the Coast Guard and by industry are highlighted throughout this issue.

In order to improve our management system through the incorporation of a risk-based approach, G-M has undertaken a number of significant initiatives. One of the first such initiatives was the development of the Risk-Based Decision-Making Guidelines. These guidelines were provided to the field in early 1997 to support the use of risk as a decision-making aid. Included in these guidelines were a basic primer on the concepts of risk assessment, risk management, and risk communications, as well as a process for employing these concepts and some general tools for doing so. Figure 1 depicts the process developed for use by the Coast Guard.

The primary benefit of a risk-based approach is the ability to optimize the use of resources to reduce risk.

As illustrated, the process includes a series of interrelated phases. The first phase is to develop some goal or focus for the process (e.g., improve safety in a particular region or a segment of the industry). With this goal, the risk assessment process can be performed to evaluate hazards or scenarios of concern. Out of that phase, a list of hazards ranked by risk can be developed. With such a list, the risk management phase can begin. In this phase, the various measures that can be implemented to reduce the risk of the hazards are identified, evaluated, and ranked by overall effectiveness. With this, an integrated plan can be developed and deployed to best manage risk. After the deployment and execution of the risk management plan, the impact (such as results achieved) can be assessed, evaluated, and refined. Throughout this process is the critical risk communication process where views and information are shared by the stakeholders involved.

In addition to the ability to maximize our effectiveness as an organization, the use of a risk-based approach to management will provide a number of other significant benefits.

Since the delivery of the guidelines, many units have used the tools and basic concepts contained in the guide to improve their effectiveness or to resolve a particular issue or problem. In addition, a number of other efforts at both the national and regional levels have been undertaken. A research and development project has been initiated to develop the second generation of the Guidelines, expanding the guidance and providing additional tools for using a risk-based approach. This project is described in greater detail later in this issue (*Applying the Risk Toolbox*, page 7). In addition, a number of Headquarters projects have been undertaken, such as the White House-mandated review of marine safety and environmental protection in Puget Sound; the review of siting issues for permanently moored vessels (*Risk-Based Approach for Assessing and Mitigating Risk to Permanently Moored Passenger Vessels*, page 43); the Port and Waterway Safety Assessment project (to support Vessel Traffic Service-related decision-making); the recent development of a risk-based decision-making guide with the Passenger Vessel Association (*Risk Management For Subchapter T Car Ferries,* page 19); as well as a number of initiatives in the international arena with the International Maritime Organization Formal Safety Assessment process. Examples of these applications are contained throughout this issue and on the Prevention Through People Internet site (http://www.uscg.mil/hq/g-m/nmc/ptp/index.htm). Significant benefits from these and other efforts have shown the value to be gained from using a risk-based approach.

In recognition of the benefits of a risk-based approach to management, and in order to achieve a more effective, integrated approach to developing risk-based decision-making as a core competency, RADM North charged a group of senior Coast Guard staff with developing a risk capability goal for the G-M Business Plan. Under the three phases of the capability goal process (develop, deploy, execute), a number of activities and milestones have been developed, as shown in Table 1. This timeline is intended to provide a detailed set of tools for using risk-based approaches to the field by 2005, including organizational, training, and resource issues.

As seen in this brief outline, a good deal of effort will go into developing appropriate tools, processes, and policies for using risk, as well as addressing the various organizational, training, and support needs of this program.

It should be noted that the Coast Guard is not alone in adopting risk-based decision-making. A number of other organizations are also moving forward in this area, including other government agencies (EPA, FAA, MMS, OSHA), classification societies, international organizations (the Formal Safety Assessment at the International Maritime Organization is one example), and maritime and other industries (petrochemical and nuclear power). By building upon the experiences and lessons learned of various Coast Guard units, we can achieve a more effective implementation of this core competency. To support this sharing of information and experiences, the Human Element and Ship Design division has developed a risk-based decision-making Internet site to complement its Prevention Through People Web site. This new web site provides information on a wide array of initiatives in support of the capability goal. It also includes a collection of the numerous applications of risk-based decision-making to marine safety and environmental protection issues (both at Headquarters and in the field). It also has a variety of tools to support the use of risk-based decision-making. The risk Web site can help all of us avoid “milking a wild cow” to achieve our results. The risk Web site can be found at http://www.uscg.mil/hq/g-m/risk/index.htm.

Applying the Risk Toolbox

By Bert Macesker,
Staff Engineer, USCG Research and Development Center

There are two broad areas where risk-based technologies are being addressed in the Coast Guard. These are operational risks internal to the Coast Guard (personnel and equipment) and external risks within the marine industry. The USCG R&D Center is providing technical support to the Program Offices charged with integrating and deploying future risk-based processes in the Coast Guard.

On the internal side, the R&D Center has been supporting the Office of Health & Environmental Safety (G-WKS) efforts towards developing a systematic understanding and management of Coast Guard operational risks with an Integrated Risk Assessment (IRA) methodology. This project has resulted in the development of a set of tools, which will be beta tested at a variety of afloat and shore units, such as high and medium endurance cutters, ISC Boston, and MSO Houston.

Coast Guard external risks, for the purposes of this article, are defined as those marine industry operations influenced by the Coast Guard such as cargo transportation, marine events, passenger transportation, and more. The R&D project "Analytical Methods to Support Risk-Based Planning and Management" is providing technical support to the Office of Design and Engineering Standards (G-MSE) in developing a core competency in risk-based decision-making (RBDM) by developing and field testing a risk toolbox. The cornerstone of this risk toolbox will be the revision to the "RBDM Guidelines," that was initially published in early 1997 as a tool to support decision-making by Marine Safety Offices and other field units. To start off this R&D project, a survey of RBDM practices at field units was made in 1998. Many of the survey respondents indicated a need for a more complete set of guidelines for risk-based techniques, including completed examples. In addi-

Figure 1. Excerpt from Preliminary Risk Analysis Worksheet.

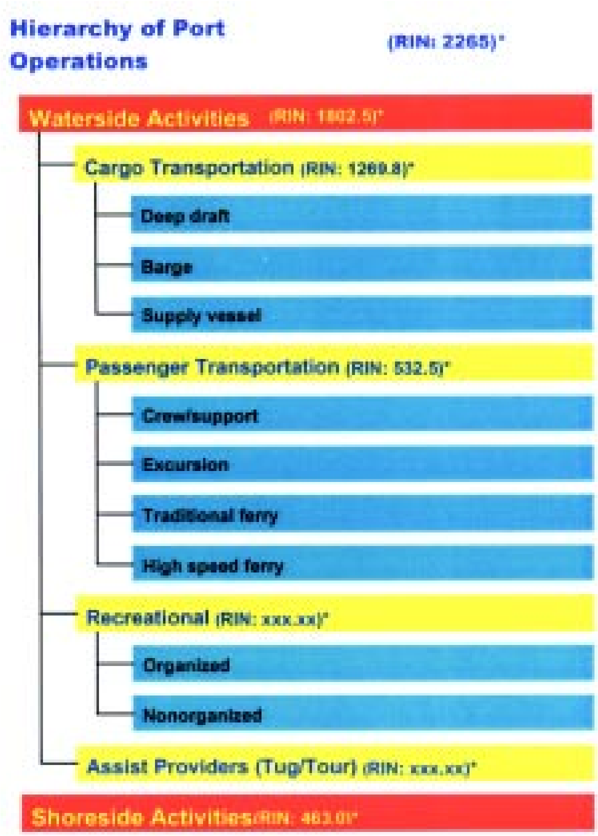
Preliminary Risk Analysis Worksheet									
Activity: Cargo loading/unloading: container									
			Frequency						
No.	Mishap	Most Significant Contributors	Major Mishap	Mod. Mishap	Minor Mishap	RIN	Certainty	Safeguards	Recommendations
1.1	Acute hazard exposure: workers	Dropped objects from cranes Physical injuries during handling operations Slips, trips, or falls during handling operations	3	4	3	1.815	Medium	Personnel qualifications: dock workers Promulgation and enforcement of industry standards: personal protective equipment and safe work practices	Consider establishing crew fatigue guidelines

tion, respondents expressed a desire for revisions to the existing guidelines to make them more usable as a training manual, with guidance on how to best select and implement risk analysis for field applications without overworking the problem. It was from this basis that the R&D Center, using ABS Group, Inc. as contractor, started to work on developing a revised set of the RBDM Guidelines, including the more complete risk toolbox.

Early in 1999, the R&D Center partnered with Activities Baltimore (ACTBALT) and ABS Group, Inc. to perform a number of risk methodology technology demonstrations. The purpose was two-fold, in that the technology demonstrations served to refine and validate some of the risk tools in the new RBDM Guidelines while addressing some immediate needs of ACTBALT.

ACTBALT desired a high-level profile of port-wide risks. A Preliminary Risk Analysis (PrRA) tool was used to characterize the levels of risk associated with a wide range of possible losses (mission, economic, safety, environmental) applicable to an operation. The PrRA is a team-based approach that employs a systematic examination of issues by subject matter experts and stakeholders who use their own experience and any available loss data to examine loss exposure. ACTBALT personnel developed a typical hierarchy for port activities and served as subject matter experts for the analysis.

Figure 2. Sample of Port Operations (note: results were based on a partial analysis performed for a proof-of-principal test. Each unit of RIN is approximately equal to $10,000 in annualized loss.).



A typical worksheet (Figure 1) documents the analysis of a particular mishap associated with one activity in the port in a logical format. The PrRA technique requires the identification of hazards and mishaps of concern in the port. Each activity, i.e., "Cargo loading/unloading: container," is analyzed by systematically examining mishap scenarios, the causes of the mishaps, and the safeguards in place to prevent or mitigate the mishaps. Low-risk mishaps and/or activities are screened from any further analysis. The analysis defines the risk associated with the mishap examined and identifies recommendations to reduce the risk. The PrRA uses a risk index number (RIN) to quantify loss exposure, i.e., product of frequency of occurrence and consequence. Selections from broad frequency and consequence categories are used. Risk data and results are captured electronically, meaning RINs are automatically generated, during the analysis.

The PrRA analysis produced a variety of results including risk matrices, risk contribution histograms, mishap frequency bounds, descriptions of high-risk mishaps, risk reduction recommendations, and cost benefit of these recommendations.

Figure 2 illustrates a slice of the port operations analyzed (both waterside and shore-side activities were analyzed) and Figure 3 shows a typical risk contribution histogram.

This overall risk profiling analysis provides a basis for supporting many types of Coast Guard decisions, such as:

• What ports/waterways, types of activities, and physical assets should receive the most enforcement attention?

• What ports/waterways need the most response resources, and what types of response activities will be most important?

• What ports/waterways need the most prevention and operation resources?

As a follow-on step to the PrRA approach, ACTBALT is working on integrating activity based cost management (ABCM) with Coast Guard risk levels associated with port activities. The combination of the evaluation of the risks in the port and the risk

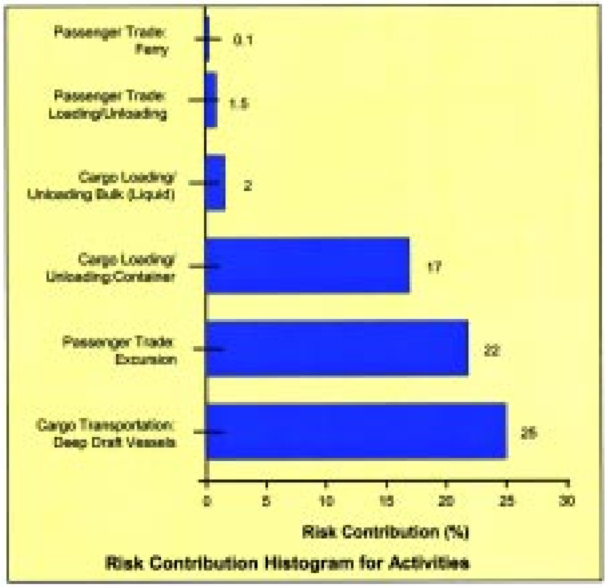
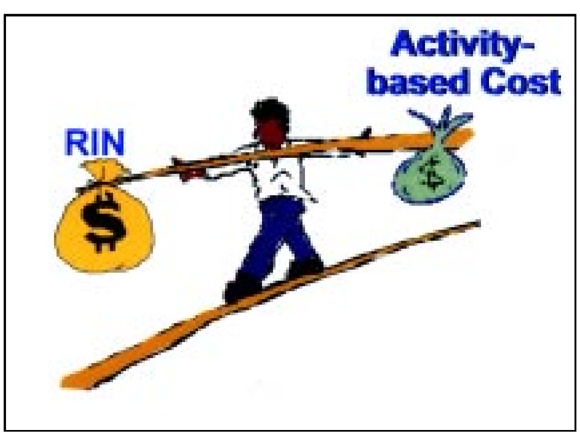


Figure 3. Histogram for port activities.

reduction provided by various interventions, along with the evaluation of the cost of the various Coast Guard intervention activities provide a powerful tool for maximizing unit effectiveness. This is conceptually illustrated in Figure 4.

Based upon the work at ACTBALT, it appears that a high-level technique like the PrRA can often quantify risk levels with sufficient certainty. However, sometimes greater confidence in a risk issue is required, e.g., more confidence that a low-risk issue is in fact low and that there are no subtle issues that were not discovered in a higher level analysis. In this case the approach has to be refined with more detailed and appropriate risk techniques. Two of these more detailed techniques under consideration for the revised guidelines were tested with ACTBALT, with the application of error-likely checklists and guide word analysis to evaluate lifeboat inspection and drills, and the use of risk change analysis to evaluate an upcoming marine event (OPSAIL 2000). This latter technique was found to have significant value in this application, and should be a valuable tool for addressing the numerous special marine events that temporarily change the risk profile for a port or waterway.

Figure 4.



This R&D project will continue to conduct activities that will validate and refine G-M's risk toolbox. Efforts are underway to determine the best way to assemble and provide the new guidelines to the field, including how to integrate these tools into the process developed in support of G-M's risk capability goal. R&D and contractor staff will team with field units to facilitate several broadly applicable field-level risk assessments that address immediate field needs in the upcoming year. In addition to providing the R&D Center the ability to test tools and techniques for the guidelines, this approach also provides the unit free consulting for important issues at hand, and provides participants with training in these management tools and approaches. The end goal for this project is to provide the field with a revised set of guidelines, including tools, job aids, and guidance on risk data sources by 2002.

In addition to this ongoing effort, the R&D Center is also initiating a related effort for G-MSE to explore and develop opportunities and approaches for Coast Guard use of risk-based technologies in regulatory development and analysis. This project is geared to support the 2005 deployment of a Coast Guard systematic risk-based regulatory frame-work projected in the G-M capability goal.

There will be hurdles in achieving a more formal risk management culture in the Coast Guard. Given that risk management is the key for achieving a high-level of protection with limited resources, the goal of the R&D Center is to fully support these initiatives by providing the tools needed, as well as to provide consulting and preliminary training to field units used in the trial program. While much work remains, there has been significant headway made. As described throughout this issue, many field units are already applying risk management concepts to their activities and business plans. In addition, there exists some regular, although limited, risk training in our infrastructure, and there are many partnership activities ongoing within the marine transportation system to foster risk management. The Coast Guard is on the right path but there is still much work to be done. The R&D Center will continue to provide support for this and other Coast Guard programs as outlined in our mission.

BENEFITS OF RISK MANAGEMENT TO FIELD OPERATIONS

(A viewpoint from Activities Baltimore)

Risk management is nothing new for Coast Guard field units. Every time a boarding officer, coxswain, or marine inspector makes an operational decision they weigh the consequences and manage risk partially based on their personal judgement and experience. The external risk management project with the R&D Center and ABS Group, Inc. takes that inherent knowledge/practices and develops a systematic approach based on a combination of experience and loss, or expected loss, to chart a course for future operations and decision-making. After six months of experimenting with Risk Assessment and Management techniques, the greatest benefit realized has been a practical understanding of how to manage all that we do with the limited resources we have. This understanding is not limited to the senior staff, but transcends the organization to field personnel managing their individual workloads. Although we are still at the early stages of implementing a unit wide risk assessment and management program, the tools we experimented with and the subsequent knowledge we gained on risk management have formed a strong foundation for us to build on. Pursuing a Port-wide management of risk has given us a framework or picture of the overall port operations in the Upper Chesapeake Bay and how Coast Guard operations influence those activities. Here a picture is not only worth a thousand words, but also brings all of our diverse Coast Guard operations into perspective. Sort of like taking an aerial photo of an operation. The only missing piece to the picture instrumental to effective management of resources-to-risk (or like an old Boatswain once said "assets to threat"), is being freed from the large number of operational mandates and constraints presently on field units.

Developing a system to assess and manage risk within a port is more of an information management task than anything else. First you have to define the system you are working in (in our case the Hierarchy of Port Operations). Then develop a mission overlay of CG missions and their influences on port operations. Here the level of detail is not important, just getting the big picture and eventually using the process of successive decomposition will work. Looking at all port operations in an area without a system to manage the information is kind of like viewing those 3D diagrams. You need a system to put things (port operations/field activities) into perspective. At Activities Baltimore we primarily focused on a broad risk assessment and management tool because, as an operational unit, we don't have the resources to conduct detailed analyses. Once finished with the big picture analysis, the CO and operational division chiefs can direct a more detailed analysis on small pieces of the picture as operations permit.

Combining this big picture with things like performance goals and Activity-Based Cost/Management will not only tell us where we should concentrate our efforts, but also how much to put into an individual effort. Unit COs, operational division chiefs, and field personnel should have the tools to make the hard decisions and a framework to validate and record the reason for making a particular decision. This will allow us to identify our needs in the form of resources, and to document the good things we are doing for outside parties like the public, the news media, and Congress. To optimize the benefits to field units, unit COs need the support from the Coast Guard's top management, and flexibility in personnel assignments and operational mandates to adjust field operations based on risk. If implemented properly, risk management could be, as a former Vice Commandant and Chief of the Office of Marine Safety and Environmental Protection (VADM Gene Henn) once said about OPA-90, "… the greatest thing since sliced bread."

By LCDR Brian Poskaitis,

Chief, Operations Prevention Division

USCG Activities Baltimore

MSO Jacksonville's Risk Toolkit

By LCDR Paul Thomas,
Chief, Port Operations Department,
MSO Jacksonville, FL

The Marine Transportation System cannot operate without risk. It never has and it never will. As Marine Safety professionals our goal is not to eliminate risk, but to identify, understand, assess, and manage it. Coast Guard Marine Safety Offices have always practiced risk management; that is they have always assessed alternatives based on expert knowledge of the relative degree of risk associated with each. It is only recently, however, that the Coast Guard (and other similar prevention organizations) have begun to quantify risk, or qualify it in a rigorous manner that allows decision makers to evaluate trends, determine relationships, and make well-grounded decisions. Risk management sounds sophisticated and scary, but it can be simple common sense put into a repeatable, consistent process. This article briefly summarizes some of the risk assessment and management tools implemented at MSO Jacksonville since 1996. The tools include vessel, facility, and port activity risk indices, and qualitative risk assessments.

VESSEL RISK MEASURES

In our approach, vessel risk is evaluated in three components: Inherent Risk Factor, Discrepancy Risk Factor, and Crew Drill Scores. Inherent Risk is the risk associated with the vessel type, age, construction, trade, route, history, etc. For foreign deep draft vessels, the Port State Control Boarding Matrix does a good job of measuring (relative) inherent risk, so we use that. For other vessels (for example, fishing, towing, T-Boats), a similar matrix can be used.

Figure 1 is the matrix we use to calculate Inherent Risk for fishing vessels. Trends in inherent risk give the Officer in Charge, Marine Inspection (OCMI) a good feel for how a fleet operates—are the vessels getting older, farther off shore, taking on a greater number of passengers? With this knowledge, the OCMI can target resources to best manage risk. The inherent risk factor is also useful for targeting inspection or examination activity to high inherent risk vessels in much the same way we target Foreign Vessels. For example, Fishing Vessel Examiners target the high inherent risk vessels (old, wood, off shore, large crew) even though it may be easier to complete an exam of a low-risk vessel (small, inland). "Targeting Efficiency" measure is used to monitor resource allocation and keep our people focused on the highest risk vessels. Figure 2 shows our "Targeting Efficiency" for the Fishing, Towing, and Port State Control fleets. That is essentially the percentage of the boardings we do on the highest risk vessels.

The Discrepancy Risk Factor is calculated using a simple matrix to assign points to all of the discrepancies noted at an inspection or examination, based on the frequency and severity of the problems. Figure 3 shows a portion of the matrix. We use the Discrepancy Risk Factor to transform the inspectors' work list (also known as an 835, referring to the form number) or outstanding items into a quantitative measure of risk. Not all 835s are equal, and this technique can help differentiate between the minor and the serious. Trends in the Discrepancy Risk Fac-

Figure 1. Inherent Risk Calculation Matrix for Commercial Fishing Vessels.

Block 1: Inherent Risk Factor (IRF)					
Factor	**0**	**1**	**2**	**3**	**Total**
Hull Material	All others			Wood *	
Vessel Age	< 10 yrs	10 – 15 yrs	16 – 20 yrs	> 20 yrs	
Route	Inland	B.L – 12 NM	12 – 20 NM	> 20 NM	
# Crew	3 or fewer		3 < # < 12	12 or more	
Overnight Accom	no		yes		
**** Includes glass on plywood or plank, but not cold molded***				IRF =	
Priority (circle one)	**P1 ≥ 10 +**	**3> P2 < 10**	**P3 ≤ 3**		

Risk Assessment Toolkit
1. Vessel Risk Index
2. Facility Risk Index
3. Port Activity Risk Index
4. Qualitative Risk Assessments

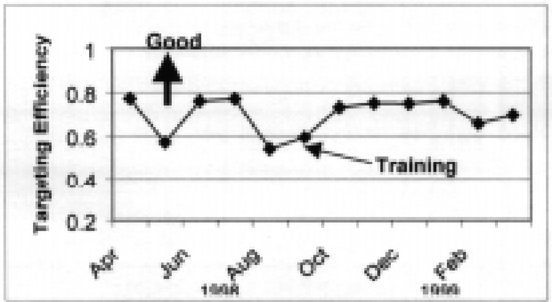


Figure 2. "Targeting Efficiency" for Fishing, Towing, and PSC Vessels.

Targeting Efficiency measures:
- How many of our "optional" vessel exams are conducted on high inherent risk vessels.
- "Optional" fleets are Port State Control, fishing vessels, and uninspected towing vessels.
- Each vessel examined is assigned a Priority (1 – 3) based on inherent risk. P1 vessels increase efficiency,

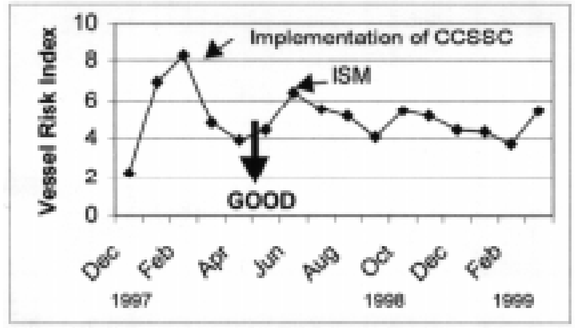


Figure 4. Vessel Risk Index for MSO Jacksonville. CCSSC is the Caribbean Cargo Ship Safety Code.

Vessel Risk Index measures:
- Inherent Risk of vessels we examine and inspect based on vessel age, construction and operations
- Discrepancy Risk of vessels we inspect and examine based on the number and type of material discrepancy we find
- Crew Risk on vessels that are required to do crew drills, based on crew drill scores

tor give the OCMI a quick view of the number and severity of problems found in the fleet.

The Crew Drill Score comes from a standard score sheet for fire, person overboard, and boat drills. The score sheets are customized for each fleet, but each translates drill performance into a risk value (the higher the drill score, the lower the risk). Trends in the Crew Drill Scores may indicate how well the training program is working and how much turnover a company experiences.

The Vessel Risk Factor (VRF) for each vessel inspected or examined is the weighted sum of the three components:

$$VRF = .25*IRF + .5*DRF + .25*CDS$$

The Vessel Risk Index is the average Vessel Risk Factors for each fleet. Figure 4 shows the Vessel Risk Index data collected at MSO Jacksonville. There are several practical uses for this data. First, by tracking the overall vessel risk index for the port, the OCMI can quickly determine if inspected and examined vessels are increasing or decreasing in risk. It is then possible to "peel back" the data and determine specifically where the problem is, and take appropriate action. Second, by comparing a particular vessel or company risk performance to the fleet or port average (average VRF for company "A" vs. VRI for the fleet), the data can serve as a basis to begin or terminate a Streamlined Inspection Program (SIP) relationship, or help in making decisions regarding operations during Y2K high-risk time frames. This same concept for measuring risk has been adopted by other prevention organizations such as fire departments and health departments, and has been implemented district-wide in District 7.

Block 2: Discrepancy Risk Factor (DRF)

Discrepancy	Number of Discrepancies	[illegible]	[illegible]	[illegible]	Total
Lifesaving					
Primary L/S		4	2	1	
EPIRB		4	2	1	
Ring Buoys		4	2	1	
Rescue Boat		4	2	1	
PFDs/Survival Suit	Limited to [illegible]	2	1	-	

Figure 3. Portion of Discrepancy Risk Factor Calculation Matrix.

FACILITY RISK MEASURES

Similar to the Vessel Risk Index, the Facility Risk Index is the weighted sum of three components: Cargo Transfer Risk Factor, Annual Exam Risk Factor, and Person In Charge (PIC) test scores. A simple risk assessment matrix is used at transfer monitors to translate the number and type of discrepancies noted into a risk measure (transfer risk factor). The use of this simple risk assessment technique in the field empowers Port Safety Petty Officers to terminate cargo transfers whenever the transfer risk exceeds a preapproved level. It also allows them to consistently focus on the key items that must be corrected before the transfer can resume.

The annual exam risk factor is calculated via a matrix that assigns a risk value based on the frequency and severity of discrepancies found at exams, similar to the discrepancy risk factor for vessels discussed above. Items that impact material safety are higher risk

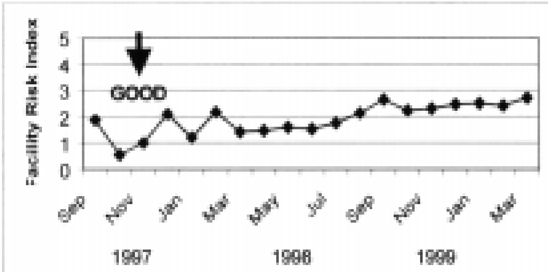


Figure 5. Facility Risk Index for MSO Jacksonville.

Facility Risk Index measures:
- Risk Level at Bi-Annual Facility Inspections based on the number and type of discrepancies we find
- Risk Level at Transfer Monitors based on the number and type of discrepancies we find
- Person In Charge (PIC) training and readiness, based on scores of tests administered at transfer monitors

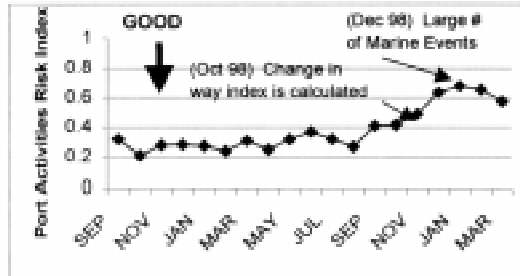


Figure 6. Port Activity Risk Index.

Port Activity Risk Index measures:
- The number and type of port activities that may increase risk on the waterway.
- Includes dredging, marine event, explosive loads, bridge work, etc.
- Waterway is segmented so that busier, more important portions of system contribute more to the index

than paperwork items. Figure 5 is the Facility Risk Index for MSO Jacksonville. Trends in this index give the COTP a quick idea of the safety culture at the ports' more than 60 facilities. In addition, the data is used to provide feedback to individual facility operators so that they know, for example, how their PICs score on tests compared to the port wide average. The Facility Risk Index concept has been implemented district-wide by District 7.

PORT ACTIVITY RISK MEASURES

The Port Activity Risk Index was developed as a Waterway Management tool not only to help track port activities, but to quantify the relative risk in a simple, repeatable, systematic fashion. Each waterway segment within the Area of Responsibility (AOR) is assigned a relative weight based on the traffic density, geographic features, importance, and other inherent risk factors associated with that segment. "High risk activities," such as dredging, bridgework, explosive operations, deadship movements, and marine events are also assigned a weight. The Port Activity Risk Index is calculated once a week based on the activities that are scheduled within the port for the upcoming week. For example, waterway segment "A" (Jetty to Blount Island) may have one area of dredging, two marine events, and one bridge under construction. The risk factor for that segment is the sum of activity weight times activity frequency. The Port Activity Risk Index for the week is the sum of the segment risk factors.

Figure 6 is the Port Activity Risk Index data for the Jacksonville AOR. In Figure 6 the monthly average Port Activity Risk Index is shown. The data has several uses. First, it gives an overall snapshot of the relative risk in the port for the week, based on the known or scheduled activities. This information can be useful to the COTP when evaluating port vulnerability to impending events such as approaching hurricanes or Y2K. Trends in Port Activity Risk Index can be used to identify seasonal or geographic risks, and can be correlated to casualties. By looking at the individual waterway segment risk factors, the COTP is able to target harbor patrols or reroute high-risk activities to lower risk segments. Finally, the Port Activity Risk Index matrix serves as a kind of electronic Gantt chart that is useful to track activities and identify where they overlap. There is a lot of opportunity to expand on the Port Activity Risk Index concept, including linking to real time data regarding ship movements, weather, tides, or the P.O.R.T.S. system. (P.O.R.T.S. is the Physical Oceanographic Real Time System. It is a service provided by the National Ocean Service that provides real time info via a web page on the state of tides, currents, water depth, temp, wind, etc, around the port.) MSO Los Angeles/Long Beach (LA/LB) has recently initiated a similar but more robust Daily Port Activity Risk Index. (See following article.)

QUALITATIVE RISK ASSESSMENTS

The 12-Step Qualitative Risk Assessment process was developed for the Coast Guard by George Washington University and detailed in the Risk-Based Decision-Making Guidelines published by Commandant (G-M). It is an exceptionally useful tool for assessing, managing, and communicating risk associated with more complex issues that impact the entire port community. At MSO Jacksonville we have successfully used the 12-step process (in varying degrees of complexity) for a variety of purposes including baseline port assessment, introduction of new trade or service to the

TWELVE-STEP PROCESS

1. Identify stakeholders and experts
2. Consult with stakeholders and experts
3. Obtain historical data/reports
4. Analyze historical incidents and accidents
5. Define system and variable states
6. Identify risk reduction measures
7. Identify dominant accident types
8. Identify dominant causal factors
9. Identify high-risk states and scenarios
10. Evaluate potential consequences
11. Evaluate effectiveness of risk reduction measures
12. Recommend/enact risk reduction measures

port, port expansion, or assessment of a specific problem or concern. The qualitative Risk Assessment has several advantages: 1) it minimizes the impact of a unilateral action by one concern within the port, 2) it requires active involvement by the key waterway stakeholders and local experts, 3) it identifies potential problems or "high risk" scenarios ahead of time so that surprises after the fact are minimized, 4) it removes emotion and builds consensus within the port community regarding appropriate actions to mitigate the risk associated with a particular issue, and 5) when conducted properly the COTP emerges as the proactive force for coordinated waterway management. Regular use of Qualitative Risk Assessments contributes to three of the Commandant's top priorities: building industry partnerships, risk management, and waterway management.

Perhaps the most illustrative use of the Qualitative Risk Assessment process at MSO Jacksonville occurred in the spring of 1997 when a local shipyard announced plans to add a major pier that encroached upon the federal channel at one of the most difficult turns in the river. The pier addition was crucial to the shipyard's success in gaining a major new contract for ship repair. To many in the port community the pier construction was seen as a unilateral move (despite the fact that proper permits had been secured years earlier) that would unduly increase the risk in that portion of the river. On one side of the issue was the shipyard with over 300 jobs and millions of dollars of revenue to add to the community. On the other side were the deep draft pilots and other river users with concerns about navigational safety in that part of the river. The port community and the media looked to the COTP to make the call.

The COTP convened a qualitative risk assessment following the 12-step methodology. Stakeholders and experts were invited to participate. Using the 12-step process, they analyzed historical data, defined system states, identified dominant accident types and casual factors, and recommended risk reduction measures to the COTP. Risk reduction measures included altering the Aids to Navigation in the area, educating the recreational boating public, and enacting port policy for deep draft vessels transiting the area. At the conclusion of the risk assessment the COTP determined that the additional risk posed by the new pier was manageable, and the project was completed.

What started as a very contentious issue was diffused by using a systematic process to analyze the risk based on expert information, and develop realistic recommendations for managing that risk. The 12-step process gave stakeholders and experts not only participation in the analysis of the issue, but ownership in the solution. This same process is now used routinely in the Port of Jacksonville for any issue that may impact the port system. In fact, the most recent assessment facilitated by the Marine Safety Office was conducted at the request of the Jacksonville Waterways Management Council (local waterway stakeholders).

SUMMARY

The quantitative risk measures described above provide an easy way for the COTP/OCMI to measure prevention efforts and manage resources. By measuring risk, we are able to focus on the issues that lead to deaths and injuries, and take action before they occur. Translating traditional activity measures into risk measures also gives a more meaningful measure of value added, and allows more efficient targeting of resources. The qualitative risk assessment is an essential tool for all Marine Safety Offices as Waterway Management and coordination of the entire Marine Transportation System becomes a higher priority and a bigger mission. The qualitative risk assessment allows us to systematically analyze complex issues, gather and use expert knowledge, remove emotion, and make informed, well considered decisions. This type of Risk Assessment Toolkit, once implemented, does not take a lot of resources to maintain, and allows us to better manage our prevention efforts.

MSO/Group LA/LB Port Activity Risk Index—An adaptation of MSO Jacksonville's Tool

By CDR Chet Hartley,
Chief, Port Operations, MSO LA/LB

Reinventing the wheel is a process some of us do more than we'd like to admit. We dedicate time and resources into developing a "brand new" process, only to find out later that somebody else had already done the same thing. At MSO/Group Los Angeles/Long Beach (LA/LB), we were able to avoid this problem with one of our risk-based approaches. We heard about MSO Jacksonville's Risk Toolkit (previous article) and were able to successfully modify it for our needs, rather than trying to create our own toolkit from scratch.

Using MSO Jacksonville's model as a guide, MSO's LA/LB Port Operations department developed a simple, systematic, repeatable, and transferable job aid to assist in classifying the average state of risk in our port for a given day. This tool, which we call the Port Activity Risk Index (PARI), is based on the evaluation of a number of factors influencing risk, such as cruise ship activity, forecasted winds, and arriving and departing vessels. PARI raises our awareness level of what is going on in the port each day, and helps put all of us in a "risk management" mindset. It is a common sense foundation that people of many different experience levels can understand.

The PARI is calculated daily, and it is simply the sum of a number of values assigned to "navigational safety risk factor" divided by a fixed maximum risk value. The more "risk increaser" activities underway in the port, the higher the subsequent PARI. Fixing a maximum risk value that each day's activities are based upon allows meaningful relative comparisons across day-to-day measurements. This risk-based approach facilitates a more accurate "threat" assessment because we are forced to identify risk factors.

How we Calculate the PARI (Refer to the Matrix Excerpt, Figure 1)

1. Determining the Risk Factors

Risk Factors (RF), the activities and conditions that have a direct relationship to risk in the port, are the foundation of the Port Activity Risk Index. RFs were determined locally during a brainstorming session. Certainly there could be an infinite number of RFs, but we built our fence around 16 of the most obvious and most common (for example, number of vessel movements, weather conditions, ATON status, and special operations taking place in the port). These are shown in the rows of the matrix in Figure 1, starting with "Number of vessels due to arrive" and continuing down through "Special Ops #3."

2. Setting the Risk Factor Value Categories

Once the 16 Risk Factors were established, we segregated Risk Factor Values into four categories: minimum (RFV_{Min}), low (RFV_{Low}) , medium (RFV_{Medium}) and high (RFV_{High}). These are shown in columns two through five of the matrix.

3. Setting the Maximum Risk Factor Value (MaxRFV)

In order to assign values to each Risk Factor category (increasingly larger numbers from Minimum to High), we had to first establish a Maximum Risk Factor Value from which all value assignments would be based. Since a 0 to 10 scale is widely recognized and easily understood, we used 10 as our Maximum Risk Factor Value for each Risk Factor. With 10 as the Maximum Risk Factor Value for 16 Risk Factors, our total possible maximum RFV is 160 (16 RFs x 10 MaxRFV = TMaxRFV = 160). The maximum risk factor value is shown in column six of the matrix.

4. Assigning the Risk Factor Value for the Category Activity Level/Risk Conditions

Pooling our experience and professional knowledge, we assigned activity levels/risk condition criteria to each Risk Factor Value category. A Risk Factor Value (from 0—no risk, to 10—highest value possible) was then assigned to each condition category. These values were entered in the cells for the risk factor being considered under the appropriate column (two through five) for each risk factor value. To allow for potential upward modifications of Risk Factor Values, no "10s" were assigned in any RFV_{High} category. Alteration of both the activity level/risk condition criteria and the corresponding RFV assigned should be made when ground truthing or data validation indicate changes are necessary.

5. Setting the Waterway Segments

The Daily Port Activity Risk Index is an average of Port Activity Risk Indexes of three major waterway segments. The three columns (SP, LA, LB) on the right of the matrix correspond to one of three main waterway segments.

6. Daily Risk Factor Value Determination for each Risk Factor in each Waterway Segment

Information is collected each morning from a number of sources to determine the actual activity level/risk condition in each of the 16 Risk Factors in each waterway segment. The corresponding RFV is determined and entered in the waterway segment column at the far right of the matrix. Risk Factors that are not applicable are not assigned a RFV (no "risk increasing credit").

7. Calculation of Each Waterway Segment Total Risk Factor Value ($TRFV_{ws}$)

Once all waterway segment applicable RFVs are assigned to individual waterway segments, the RFVs for each waterway segment are totaled and entered in the last row of the matrix. In the example shown, San Pedro (SP) received a 17 for the $TRFV_{ws}$, Los Angeles (LA) received a 10, and Long Beach (LB) received an 8.

8. Calculation of Each Waterway Segment Daily Port Activity Risk Index ($PARI_{ws}$)

The Daily Port Activity Risk Index can now be calculated for each waterway segment using the results from steps 3 and 7 in the following formula:

$$PARI_{ws} = (TRFV_{ws} / TMaxRFV) * 100$$

where:

• $PARI_{ws}$ = Port Activity Risk Index for an individual waterway segment,

• $TRFV_{ws}$ = Total Risk Factor Value for an individual waterway segment,

• TMaxRFV = Total Maximum Risk Factor Value per waterway segment = 160

Note: The equation portion ($TRFV_{ws}$ / TMaxRFV) is multiplied by 100 in order to display PARI as a percentage (for ease of recognition and comparison).

9. Calculation of the Overall Daily Port Activity Risk Index

The overall PARI ($PARI_{Overall}$) is an average of the three waterway segment PARIs.

$$PARI_{Overall} = (PARI_{SP} + PARI_{LA} + PARI_{LB}) / 3$$

10. PARI Risk Scale and Corresponding Color Zone

To enhance quick understanding and "common sense" qualitative recognition of the PARI (for example, how "risky" is a 14.2%), we employed the concept of a Risk Scale and assigned colors to different risk states or levels:

Risk Scale	
Color Zone	Risk Level
Green	Low
Yellow	Medium
Red	High

11. PARI Risk Limit Values

Once the Risk Scale concept was implemented, we again used our experience and professional knowledge to establish the boundaries or "thresholds" that segment the different Risk Levels. Our system has two scales:

• 0 to 160 (the MaxRFV scale) and

• 0 to the sum of all the RFV_{High}s (currently 103 for us, but could change with an increase or decrease in one or more RFV_{High}s).

To correlate the two scales we divide the total of RFV_{High}s (103) by the TMaxRFV (160). 103/160 = 64%. This means that if we assign the highest Risk Factor Value for each of our 16 Risk Factors, the total would be 64% of our TMaxRFV scale.

To segment the 0 to 64% (or 0 to 103) scale, we used a conservative approach which was prone to highlight marginal as well as high risk levels. Our Risk Limits were determined as follows:

To perform a coarse qualitative ground truthing, we calculated PARIs for a number of different states (or days); some were for known "normal"

Limit Designator	Limit Value Calculation		Limit Value
Low Risk Limit	10% of (Total RFV_{High}8 / TMaxRFV)	10% of (103/160)	**6%**
Medium Risk Limit	25% of (Total RFV_{High}8 / TMaxRFV)	25% of (103/160)	**16%**
High Risk Limit	50% of (Total RFV_{High}8 / TMaxRFV)	50% of (103/160)	**32%**

daily conditions (low/medium risk) and some were for thought-experiment "abnormal" conditions (medium/ high risk). This effort dominantly validated the Limit Value designations.

Correlating the scales to determine the Risk Limit designators facilitates a consistent relative comparison of PARI to Risk Limit designators should Risk Factor Values change in the future. (As Risk Factor Values increase, the relationship between the PARI and the Risk Limit designators remain fairly constant.)

12. Risk Color Scale/PARI Value Correlation

PARI Value Range	Color
From 0 to 6% (LRL)	Green
From 6% (LRL) to 16% (MRL)	Yellow
From 16% (MRL) to 32% (HRL)	Red

13. PARI Presentation

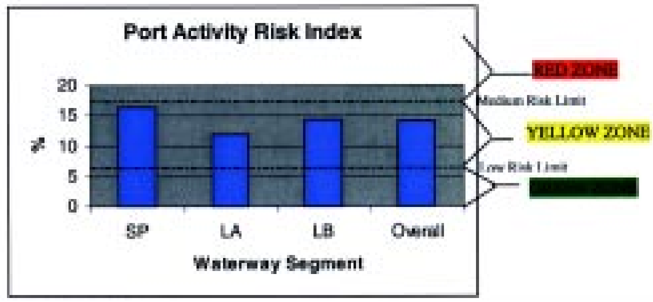
The Daily Port Activity Risk Index is calculated prior to 8:00 a.m. each work day. The PARI is presented at the morning Operations brief in the command center. "Abnormal" factor values are highlighted if the PARI is out of a normal expected range.

If, for example, our $PARI_{Overall}$ was 14.2%, we would present this PARI as in the "upper third" of the Yellow Level, approaching the High Risk Limit and the Red Level (describing an overall "risk state [or condition] snapshot" in the port as just below the "high risk" range). We would also outline the "abnormal" Risk Factors that have elevated the PARI to this level (eg. high winds, two dredging projects extending into the channel more than 25%, a major main channel range light extinguished and an unusually high number of vessel arrivals.)

Risk Reduction Measures—The Reason for the PARI

We use our PARI as a "leading indicator" to only assess the risk level in the port for the day. It does not account for nor credit any previously implemented risk

$PARI_{ws}$	
$PARI_{SP\ (San\ Pedro\ Bay)}$	16.3
$PARI_{LA\ (Los\ Angeles)}$	11.9
$PARI_{LB\ (Long\ Beach)}$	14.4
$PARI_{OVERALL}$	14.2



reduction measures. The primary purpose is to accurately assess the risk state so that appropriate and effective risk reduction measures can be implemented to prevent accidents. The effort necessary to calculate a PARI would be wasted and futile without follow-on risk reduction measure consideration and implementation.

Once the PARI is calculated and "abnormal" risk factors have been identified, previously implemented risk reduction measures are presented. Members at the Operations brief discuss if any additional managerial responses and/or risk reduction measures would be effective and appropriate.

As noted, our Waterway Management Division collects the data, calculates the PARI, and reports the PARI at each morning's Operations Brief. Our department heads and Command Duty Officers then use the PARI as a "snapshot" of the risk level in and around the LA/LB port complex for the coming day. Being aware of the "daily port risk level" will add value when responding to and making decisions concerning real time proposals and operations. Our ultimate goal is to validate the accuracy of our PARI by correlating PARIs with near-miss/casualty data over a period of time. If we are able to identify (predict) these "relatively riskier states" (leading indicator) with accuracy and consistency, we can then better apply effective and concentrated risk reduction measures when they are needed most. In the interim, we have found this tool to provide significant value when performing daily operations.

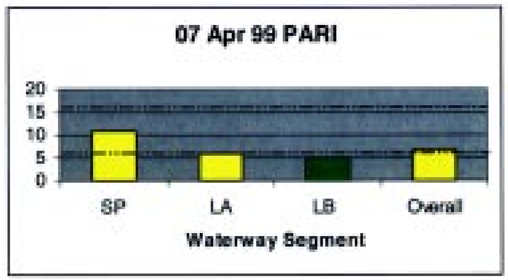
Example Operations Briefing Report:

"The overall Port Activity Risk Index for today is slightly above the Lower Risk Limit—in the 'lower one-quarter' of the Yellow Zone (describing an overall 'risk state [or condition] snapshot' in the port as barely in the 'medium risk' range).

"Risk Factors are generally normal (minimum or low values): the sea state outside the port is 3 to 5 feet, forecasted winds are between 11 and 25 knots in all segments, one major aid to navigation is extinguished in Long Beach and there are two dredge projects currently underway affecting all three segments.

"The ANT Team is responding to the major aid and a number of risk reduction measures are in place for the two dredging projects (fastfax, BNTM, LNTM, COTP Public notice, announcements at Harbor Safety Committee meetings, coordination meetings and daily contractor dredge position faxes to major port users). We will keep an eye on the winds and implement our High Winds Quick Response Sheet should winds exceed 25 knots.

"We believe these risk reduction measures are appropriate and effective for the assessed state."



Medium Risk Limit

Low Risk Limit

Figure 1.

Risk Factor (RF)	Risk Factor Value RFV_{Min}	RFV_{Low}	RFV_{Medium}	RFV_{High}	Max RFV	SP	LA	LB
Number of vessels due to arrive	0 to 5	6 to 12	13 to 20	Over 20	10	2	1	1
	1	2	3	5				
Number of vessels due to depart	0 to 5	6 to 12	13 to 20	Over 20	10	2	1	1
	1	2	3	5				
Number of vessels due to arrive under deviation	1	2	3	Over 3	10			
	1	2	3	4				
Forecasted Wind (kts)	5 to 10	11 to 25	26 to 40	Over 40	10	4	4	4
	2	4	6	8				
Forecasted Visibility (nm)	2 to 5	1 to 2	1/2 to 1	Less than 1/2	10	2		
	2	4	6	8				
Forecasted Sea State (combined seas & swell in ft)	1 to 3	3 to 5	5 to 10	Over 10	10	4		
	1	2	3	4				
Vessel Radar/ Tracking Equip. Status (Norctrl Racal Deca)	Minor capability reduction	Medium capability reduction	Major capability reduction	Non-operational	10	1	1	
	1	2	3	4				
ATON Status Range, lighthse, channel marking buoys/ structures	1 major	2 major	1 or 2 major with 2 or more minor	3 or more major and 1 or more minor	10			1
	1	2	3	4				
Cruise Ship Activity (Day of week)	Other	Sun	Mon & Fri	Additional P/V on M&F	10			
	0	1	3	5				

Risk Factor (RF)	Risk Factor Value RFV_{Min}	RFV_{Low}	RFV_{Medium}	RFV_{High}	M RF V	SP	LA	LB
Special Ops #3 Construction, Crane, Movie, Jack-up rig, etc.	No impact on channel/ traffic	Minor impact on channel/ traffic	Medium impact on channel/ traffic	Significant impact on channel/ traffic	10			
	1	3	5	8				
				$TRFV_{WS}$		17	10	8

TMaxRFV	160

$TRFV_{SP}$/TMaxRFV	$TRFV_{LA}$/TMaxRFV	$TRFV_{LB}$/TMaxRFV
17/160	10/160	8/160

$PARI_{SP}$	$PARI_{LA}$	$PARI_{LB}$	$PARI_{OVERALL}$ (%)
11%	6%	5%	7%

Risk Management for Subchapter T Car Ferries

By I. Bernard Jacobson, General Manager, North Ferry Co., Inc., Shelter Island Heights, NY

Recently, North Ferry experienced two incidents that could have put passengers' health, or even their lives, in jeopardy with slightly different sets of circumstances. The incidents led to important improvements to the design of our terminals' ramp-to-ferry connection system and to crew procedures for using it. Recognition of such risks became a major motivator for our management and owners to take some long, hard looks at safety systems and procedures. It also interested me in working with the Passenger Vessel Association/U. S. Coast Guard (PVA/USCG) team developing a new Risk Management Guide For Passenger Vessel Operators. North Ferry volunteered for a test run of the new methodology.

We assembled a workshop team: ferry captains, senior dockhands, managers, our port engineer, and even a senior member of our Board of Directors. We also invited a Coast Guard representative of the local Marine Safety unit to work with us during our daylong workshop.

As we are all learning, risk is the probability or likelihood of an accident or incident taking place (such as a hard landing or a fire onboard) combined with the magnitude of the consequences (injuries, fatalities, or property damage). The PVA/USCG Risk Guide provides a handy process to evaluate and control such risks. We can identify and analyze potential risks and then find ways to eliminate, or—more likely—reduce our exposure. The first step—risk assessment, which involved identifying the operational scenarios and specific hazards for each—was a crucial part of the process. This provided the framework for the risk analysis. We then engaged in a brainstorming exercise to name all kinds of potential hazards, including those while loading, transiting, and unloading. The second step—risk analysis—ranked all of these hazards in terms of their likelihood and their impacts. To make them consistent as a whole, we often compared them with each other and re-scored their probabilities and hazards.

We now recognized that one day was not enough to complete the last step—risk management—so we focused our efforts on the most serious hazard, a vehicle fire on deck, to create a causal chain model to use for this and other types of risks (Figure 1).

Once the linkages of the CAUSE-INCIDENT-ACCIDENT-CONSEQUENCE sequence were laid out, possible interventions were identified to prevent the vehicle fire from happening and then spreading. This proved to North Ferry that it is not necessary to adopt expensive solutions to reduce risk. We are using the results to identify cost-effective changes in training, procedures, and equipment to improve safety. We have installed onboard public address (PA) systems to better inform passengers of our No Smoking/Engines Off policies. The PA is also used to warn standing passengers of hard landings and for emergency communications. A more expensive change was the laying of a water main to a new fire hydrant and hose rack at our terminal.

CAUSE ⇨ INCIDENT ⇨ ACCIDENT ⇨ CONSEQUENCE

Figure 1.

Our workshop taught us that the PVA/USCG Risk Guide is fundamentally sound and provides a good introduction to the risk concept, analysis, and cost-effective risk management. Some specific lessons we learned during the workshop are:

1. A trained facilitator is a major asset in getting organized and keeping your eye on the ball.
2. A follow-up evaluation is needed to take another look at the analysis and proposed interventions.
3. We needed at least two days to cover our important risk exposures.
4. If Coast Guard personnel are participating, they must treat what they hear as confidential. Of course, there is nothing illegal being discussed, or even thought about.
5. This is a key part of a culture of safety that our company is committed to that produces a very cost-effective management tool.

North Ferry recognizes Risk Management as a business tool that helps us identify and manage the highest priority issues in our organization. Our company mission is to provide the safest, most reliable, and economical ferry service to all our regular and occasional users. We carried over 1.1 million people in 1998, with about 620,000 of them driving vehicles onto our ferries. Therefore, our primary concern must not only be safety for our employees and our property, but also for our customers and their property. This risk management approach supports our bottom line—safety.

Crisis on the Coast: The Grounding of the *M/V New Carissa*

By Captain Michael Hall, Commanding Officer, Group Commander, Captain of the Port and Officer in Charge, Marine Inspection, Marine Safety Office/Group Portland, OR, and
Commander Jacqueline Wyland, Emergency Response Planner, Marine Safety Office/Group Portland, OR

A potentially disastrous fuel oil spill on the Pacific Coast was successfully averted this past winter. The decision-making during the response to the grounding of a bulk freight ship, with nearly 400,000 gallons of fuel oil on board, illustrates many fundamental principles of sound risk management. This incident was unusual in that the ship became grounded twice. The response set a precedent by burning the ship's oil on board and extraordinary means—including a torpedo—were used to sink the ship in order to reduce the risk of a major oil spill. This case illustrates the value of a structured approach to decision-making, as well as the importance of cooperation between affected parties during decision-making, and the challenges posed by heavy weather.

This experience shows how the risks and hazards of a situation can change, requiring flexibility and continual reassessment of the best options for action. It is a good demonstration of how the use of a structured decision-making process can help make the best of a bad situation.

THE GROUNDING

On the night of February 3, 1999, there were 23 crew on board the *M/V New Carissa*, a 639-foot bulk freight ship of Panamanian registry. The vessel carried no cargo as it was inbound from Japan to pick up 37,000 tons of wood chips at Coos Bay, Oregon. However, a strong ocean storm, with winds that reached 39 knots and seas up to 26 feet, was hitting the central Oregon coast that night. The pilot assigned to join the ship indicated that it shouldn't enter the bay under those conditions and that he would join the ship the next day. As the ship turned away from the bay, the captain ordered the crew to open the four empty holds, and anchored the ship about a mile and a half offshore. During the storm, the ship dragged anchor and drifted toward shore. The crew tried to weigh anchor and move the ship, but during the early morning hours of February 4, it went hard aground about 150 yards off a scenic stretch of sandy beach three miles north of Coos Bay.

THE RESPONSE ORGANIZATION

The CG Marine Safety Office (MSO) in Portland, Oregon, received the report of the grounding from CG Group North Bend, Oregon, at 9:00 a.m. on February 4. The unit immediately activated its Crisis Action Center and began implementing its Incident Command System (ICS) watch quarter and station bill for a large scale grounding/potential spill scenario. Personnel were immediately dispatched to form a forward command post in the Coos Bay area. Captain Mike Hall, the Captain of the Port at MSO Portland, and the predesignated Federal On Scene Coordinator (FOSC), activated a response organization headed by a Unified Command. The Unified Command (UC) was composed of the FOSC, the State Incident Commander (SIC) and the Responsible Party (RP). The RP contracted Smit Americas, Inc., as salvor. Within hours, various spill and salvage experts were en route, including equipment and crews from the Coast Guard's Pacific Strike Team, an oil and chemical spill response force based in Novato, California, and a Scientific Support Coordinator from the National Oceanic and Atmospheric Administration. Together the UC rapidly called upon a number of federal, state and local agencies, and other stakeholders and contractors to assist with the response. Before the incident ended, 58 different agencies and groups, and approximately 700 people, would lend their expertise and resources to the response and prove the value of a unified operation.

SETTING AND REVISING COMMON OBJECTIVES

Decision 1: Initial objectives and handling of crew

Initially the Unified Command agreed upon three objectives: (1) ensure personnel safety; (2) refloat the vessel; and (3) prevent the discharge of oil. Refloating the vessel was the preferred goal, as long as it remained intact. However, the longer the ship remained grounded, the greater the risk of it leaking its load of fuel oil. Heavy surf and high winds throughout the next several days made boarding the vessel difficult and dangerous. Nonetheless, the crew of the ship was evacuated for safety reasons and salvage and response personnel boarded the ship via Coast Guard Air Station North Bend helicopters to conduct a structural assessment. There were no salvage vessels in the vicinity of Coos Bay capable of pulling the ship off the sand. The *Salvage Chief*, a salvage vessel based in Astoria, Oregon, approximately 170 nautical miles to the north, was thereby placed on alert and began taking on fuel and provisions with the intent of proceeding directly to the scene. However, by the time the *Salvage Chief* was ready to depart Astoria, the same winter storm had closed the bar at Astoria, and its departure was delayed for two days.

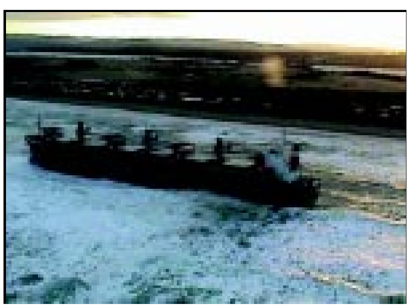
Decision 2: Revising objectives based upon effect of changing weather

Because the ship could not be refloated promptly, the UC reassessed the risks and revised their objectives accordingly. Their objectives became to: (1) ensure personnel safety and the safety of the local community; (2) minimize impacts on the environment; and (3) salvage the vessel. The environmental risks were substantial. The grounding was close to the South Slough National Estuarine Reserve within Coos Bay. The bay and the reserve contain highly productive marine life including extensive tide flats and provide habitat for migratory shorebirds, seabirds, and marine mammals. By day five, oil began to leak from the ship, and small tarballs began to appear on ocean beaches. Beach cleanup and booming of sensitive habitats and marinas in the estuary were underway; oiled bird recovery and rehabilitation operations began as well.

DIFFICULT CHOICES

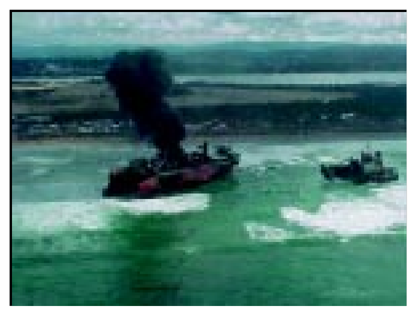
Decision 3: Revising salvage plan based upon weather and vessel hull condition (or the decision to burn)

On February 9, after finally crossing the Astoria Bar, and transiting to Coos Bay, the *Salvage Chief* was on scene and preparing to pull the ship off the beach. But by then winds and waves had driven the *M/V New Carissa* approximately 600 feet further shoreward, beyond the operational reach of the salvage vessel and its ability to safely anchor near the surf zone. On February 10, the FOSC, SIC, RP, and salvor determined that trying to pull the damaged ship off during the severe storm forecast to arrive that night would probably cause hull failure. If that happened, the ship would likely release most of the fuel onboard. The UC concluded that waiting to see what would happen to the ship's integrity that night was not an option they would accept. They determined to either try to pull the ship further ashore to facilitate lightering, or to attempt an "in situ" (on board) burn.



The *M/V New Carissa* aground 3 miles north of Coos Bay, Oregon.

In situ burn of the *M/V New Carissa's* fuel oil on February 11.



The M/V New Carissa was split into two pieces by rough weather sometime late February 11 or 12.

This was one of many decision points during the response operation when working collaboratively with the Regional Response Team, stakeholders and other agencies paid off handsomely. The UC described the options to the resource agencies and environmental representatives aiding in the response and explained that one of these two options would be selected in a few hours. The UC asked for a consensus recommendation as to which option would better protect the environment. Despite the many uncertainties facing them, the wildlife and habitat experts appreciated the necessity to act rather than to do nothing, which would increase the likelihood of a massive spill. They endorsed the UC's decision to burn. It was a tough decision, but as Teddy Roosevelt has been quoted as saying, "In any moment of decision, the best thing you can do is the right thing, the next best thing is the wrong thing, and the worst thing is nothing." This decision was also made easier when the FOSC and RP surveyors determined on February 10 that the ship was already a constructive total loss.

THE IN SITU BURN

Decision 4: Developing the burn plan

The primary concerns of the UC were the safety of the response crews and the safety of the local communities. Although pre-approval protocols were identified and followed, as specified in the Northwest Area Contingency Plan, there were many safety concerns. These included air monitoring, detonation, burn accelerants, and evacuations of work crews that had to be resolved before intentionally igniting over 400,000 gallons of fuel oil, approximately 350,000 gallons of which was "Bunker C" (a heavy fuel oil that is difficult to clean up). A Coast Guard naval architect/marine engineer worked with a Navy Explosives Ordinance Disposal (EOD) team from Whidbey Island, Washington, to identify where to place explosives on board to ignite and sustain the first ever "controlled" burn within the lower 48 states. The first attempt to ignite the oil failed, but the next day, February 11, the Navy EOD team used 400 pounds of explosives to rupture the fuel tank tops while a locally brewed napalm mixture assisted with ignition and helped sustain the fuel burn. The fire burned for 33 hours and successfully consumed about half of the ship's fuel load. The risk of a major spill had been cut in half. But there were still an estimated 130-155,000 gallons of fuel on board. Furthermore, due to the pounding surf, the ship had split into two pieces, a bow and a stern section. These sections began to drift apart from each other in the unrelenting heavy waves and wind.

LIGHTERING AND THE FIRST TOW TO SEA

Decision 5: Dealing with two pieces

The grounded vessel, broken in two, continued to release oil. The greatest risk came from the bow section, which carried the majority of the remaining oil. On February 17, the UC decided that the most effective option to minimize and mitigate the further discharge of oil was to tow the bow section to sea and scuttle it. The RP requested that Smit Americas, Inc., refloat, tow, and dispose of the bow section where its impacts would be minimized: 248 miles offshore at a depth of about 1600 fathoms and a water temperature of 34 degrees Fahrenheit. This plan was approved by the FOSC and received the concurrence of the Regional Response Team. For the tow, the RP contracted the oceangoing tugboat *SEA VICTORY*. Smit Americas ordered an especially long, synthetic floating towline to be flown in from Holland, with an ETA of February 21.

Decision 6: Offloading remaining fuel

The UC decided to remove as much unburned oil as possible while waiting for tow preparations to be completed. Lightering would be difficult due to the high viscosity of the oil (variously described as similar to thick peanut butter, molasses, or soft asphalt) and heavy, pounding surf. The main options were to: (1) pump oil into tanks and lift them by helicopter to shore; (2) warm the oil and pump it to shore; and (3) use a viscous oil pumping system to move as much oil as possible to shore tanks. Because of time constraints and the lead time required for the first two options, the third option was chosen. The lightering crews endured difficult and dangerous conditions in a heavy storm to pump about 110,000 gallons of liquid off the ship. Unfortunately, nearly all of it was found to be seawater. The lightering was secured on February 22, with most of the 135,000 gallons of fuel still on board, as the bow section was nearly ready for sea.

Decision 7: Towing the bow section (part 1)

On February 23, a helicopter attempted to hook a towline from the tugboat *Sea Victory* to the bow section of the vessel, but high winds and heavy seas precluded hookup for three days. Finally, on February 26, the towline was attached and the tug began to pull with 7200 horsepower from its twin engines. Over the next three days, the bow slowly inched seaward, aided by high tides and scouring of the sand by heavy waves. It finally cleared the shallows on the evening of March 1, and to the relief of everyone involved, was towed out to sea. Following the bow was the *OSRV Oregon Responder*, a 209-foot oil-skimming vessel. However, high seas of yet another incoming winter storm forced the skimmer to return to port.

Decision 8: Preparing for a drifting bow section

Unfortunately, about 50 miles offshore, after a tow of more than nineteen hours, the last six hours of which exposed the vessels to an extremely brutal winter storm (30-40-foot swells and 60-knot winds and higher gusts), the operation abruptly ended. At 5:18 p.m., the towline (the 2 1/4-inch wire rope coming off the drum at the chafing plate) parted at the stern of the tug, setting the bow section of the *M/V New Carissa* adrift. Booming and beach cleanup crews were mobilized as soon as the bow section started to drift shoreward. The bow drifted at up to 7 knots on a north-northeast course until fourteen hours later, to the dismay and consternation of the public and the responders, it went aground again at Waldport, Oregon, at 7:00 a.m. on March 3.

THE SECOND GROUNDING AND TOW

Decision 9: Towing the bow section (part 2)

Environmental impacts from the second grounding on the beach at Waldport could be severe. The bow grounded at the Governor Patterson Memorial State Park, a locale rich in marine, estuary, and shore wildlife. Three species of birds there are listed under the Endangered Species Act: the bald eagle, peregrine falcon, and marbled murrelet. The nearby Alsea River estuary is a relatively undeveloped water body that provides important rearing habitat for juvenile Chinook salmon and is rich in Dungeness crabs, clams, and other sea life. Just 16 miles north is Yaquina Bay, a highly productive estuary with the state's largest commercial fishing fleet, commercial oyster farms, and the Newport Aquarium, which is dependent upon clean seawater.

Storms once more impeded efforts to remove the bow section from the beach. But on March 8, the *Sea Victory* successfully pulled the bow off the beach, using a 2400-foot Navy towline. Accompanied by the tug *Natoma*, the *Sea Victory* towed the bow 280 miles out to sea by March 11.

SINKING THE BOW SECTION

Decision 10: Sinking the bow section

On March 11, in an extraordinary joint effort by the Coast Guard and the Navy, the bow section of the *M/V New Carissa* was successfully sunk 282 nautical miles offshore of Oregon in 1811 fathoms of water. The U.S. Navy EOD Mobile Unit 11 worked with a Coast

Shells from the *USS David R. Ray* pound the bow section of the *M/V New Carissa* (AP Photo).

Guard naval architect/marine engineer to place aboard the bow section 400 pounds of directional explosives, strategically located to initiate flooding. The explosives were detonated, followed immediately by 69 rounds of cannon shells fired by the *USS David R. Ray*, a 563-foot Navy destroyer. After about 40 minutes, the vessel had still not sunk . . . something more would be needed. With night coming on and a significant storm building, the submarine *USS Bremerton* fired a single MK-48 torpedo, which the Combat Information Center operators heard screaming toward the wreck. The bow tipped and silently slid beneath the surface. At its final resting place in deep water, at 34 degrees Fahrenheit, the thick oil would have minimal impacts to water quality or sea life. Although a surface oil slick was reported immediately following the sinking, the *OSRV Oregon Responder* found nothing to skim. The mission was a success. Oregon's Governor, John Kitzhaber, celebrated the news by proclaiming March 11 to be "two-thirds of the *New Carissa* at the bottom of the ocean day." Several overflights of the sinking have revealed no signs of oil pollution.

SALVAGING THE STERN SECTION

Decision 11: Dealing with the stern

The stern section of the wreck is still aground at Coos Bay. Although the stern section included one fuel bunker tank, a diesel oil tank, and the engine room, most of its oil had already leaked or burned. However, a substantial threat remained from the oil on board. Thus, approximately 20 additional day tanks, reservoir, crankcases, and other parts were opened and cleared of oil. The oil was removed from the engine room by skimming, or pumped directly into temporary storage tanks for removal from the vessel. The removal operations were successful in removing approximately 14,000 gallons of an oil mixture, and over 100 cubic yards of debris from the stern section. On May 20, the Coast Guard and its contractors safely completed removal operations; the FOSC determined that the substantial threat of a discharge was mitigated and oil removal operations aboard the stern section were completed. As the operations moved from a pollution response to a salvage operation, the Governor emphasized that it was in the public's interest to have the wreck removed from Oregon's beaches entirely. The RP committed to the Governor of Oregon to contract for the total removal of the wreck, and to do so using a seaward approach. This methodology will ensure best "net benefit" for this environmentally sensitive scenic area. The contract for the ship breaking was awarded to Donjon Marine Co. and Fred Devine Diving and Salvage. The work commenced in June 1999. Dismantling and removal operations were carried out over the summer, with some of the structure successfully removed and airlifted to the beach for disposal. Despite delays caused by frequent periods of heavy surf and the need to do extensive underwater patching to refloat part of the wreck, the contractors estimate that removal will be completed by October. Small tar balls were found in the vicinity of the stern but posed no threat to the environment. If the final stages of wreck removal, including cutting through damaged fuel oil tanks, cause a release of oil, the Coast Guard and state officials are ready to respond quickly and appropriately to protect the environment.

SHARED OBJECTIVES GUIDED DECISION-MAKING

The UC succeeded in meeting its highest priority objectives by unhesitatingly making decisions and promptly taking actions that were consistent with minimizing risks and attaining the agreed-upon objectives. The top priority objective was personnel safety, and we are gratified to report that there were no significant injuries to personnel engaged in the response, only a small number of minor injuries, and no injuries within the local community. The second priority objective was to minimize impacts to the environment. Although about 70,000 gallons of oil were spilled during the incident, we succeeded in preventing approximately 82% of the total volume of oil from truly blanketing Oregon's shoreline and wildlife. (Of the 400,000 gallons on board, we burned about 200,000 gallons, and discharged about 70,000 gallons. About 130,000 gallons sunk aboard the bow.) The third priority, to salvage the ship, was thwarted first by the weather and then was superceded by safety and environmental protection objectives.

The UC issued Decision Memos to document their decisions and consensus at critical points throughout the response. The memos communicated to everyone involved the reasons for the actions taken and how they would help attain the agreed-upon objectives. They reduced confusion and established an important record of events. Also, the extensive use of the internet, on which almost all information was posted, has resulted in more than 1.25 million site hits and significantly reduced incoming questions and inquiries.

THE CAUSE OF THE GROUNDING AND ITS COSTS

The Coast Guard convened a one-person board of inquiry in February to determine the cause of the grounding. The conclusions of that inquiry were still pending at the time this article was being written.

Costs of the cleanup topped $20 million by April 20. Federal costs of approximately $6.3 million to date have initially been covered by the Oil Spill Liability Trust Fund; however, the Coast Guard will seek reimbursement from the responsible party.

PREPAREDNESS AND THE HUMAN FACTOR

The response was built upon a solid foundation of planning and training which preceded the incident. For example, Coast Guard personnel, as well as many other response participants, had been trained in the Incident Command System in the classroom and in joint exercises with the Maritime Fire and Safety Association, the Columbia River Steamship Operators, and Clean Rivers Cooperative. Many of the issues which arose—including in situ burning—had been anticipated and were discussed in general terms in the Northwest Area Contingency Plan (NWACP). The NWACP and Geographic Response Plans also provided general documentation of the resources at risk, and how best to mitigate those risks.

Altogether, the series of decisions made by the UC in consultation with the involved stakeholders highlight the value of a structured approach to decision-making. As shown, there were many stages throughout the response where decisions had to be made to deal with emerging situations and/or changing conditions. At each step, a detailed process was used to carefully evaluate the situation and weigh options and potential outcomes. Armed with this information, and with the insights of the stakeholders, the UC was able to make the best of a bad initial situation and difficult conditions.

The human element was just as important as preparedness. The cooperation and partnerships of local, state and federal agencies, business leaders, and volunteers made the response a success. The working relationships and mutual respect necessary to perform a complex joint operation had been forged and cultivated in the years and months before this incident. As VADM J. C. Card, U. S. Coast Guard Vice Commandant, once said, "When you need a friend, it is too late to make one."

A Structured Approach to Risk Assessment and Risk Management

By W. E. Jenkins, Vice President, Mobil Shipping and Transportation Company and
R. H. J. Shilling, Manager Maritime Relations, Nautical Services and EHS, Mobil Shipping and Transportation Company

For many years Mobil Shipping and Transportation Company utilized a traditional approach to safety, health and environmental protection. We designed and diligently applied an array of progressive programs and we established a pervasive safety culture throughout our organization and fleets. These efforts were very successful. As a result, our employee injury frequency rate in 1992 was approximately eight times better than the U.S. marine transportation industry average, and we developed an excellent record with respect to the prevention of major incidents. Our performance continued improving over the next four years. While this represented leading performance, we still were not satisfied. We decided to modify our approach in order to accelerate progress toward our target of zero incidents.

In 1997, Mobil established a worldwide Environmental, Health & Safety Management System (EHSMS). This disciplined management framework provides a structured, systematic, and targeted approach to all aspects of safety, health, and environmental protection. EHSMS consists of 11 elements that are broad categories within which efforts are focused. Each element contains clear and specific management expectations that should be met, and accountability for meeting each individual expectation is clearly established within our organization. The system also requires us to regularly re-examine the status of all of our existing programs as compared to the EHSMS expectations and to improve systems and practices where appropriate. One of the elements and a number of detailed expectations involve risk management.

MOBIL SHIPPING AND TRANSPORTATION COMPANY LOST TIME INJURY RATE TREND

Risk is a function of likelihood and consequence. The risk management element in EHSMS has helped us to continue expanding the application of *systematic* methodologies for evaluating *both* the likelihood and consequence of potential hazards. This more formal framework for identifying, assessing and prioritizing potential risks is helping us become even more effective at targeting our efforts where they will provide the greatest overall risk reduction benefit.

ELEMENTS OF THE ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT SYSTEM (EHSMS)

ELEMENT 1: POLICY AND LEADERSHIP
ELEMENT 2: PERFORMANCE IMPROVEMENT
ELEMENT 3: SAFETY AND HEALTH
ELEMENT 4: RISK MANAGEMENT
ELEMENT 5: INCIDENT REPORTING AND INVESTIGATION
ELEMENT 6: CRISIS PREPAREDNESS
ELEMENT 7: ENVIRONMENTAL PROTECTION
ELEMENT 8: PRODUCT STEWARDSHIP
ELEMENT 9: TRAINING
ELEMENT 10: COMMUNITY RELATIONS
ELEMENT 11: LEGAL REQUIREMENTS

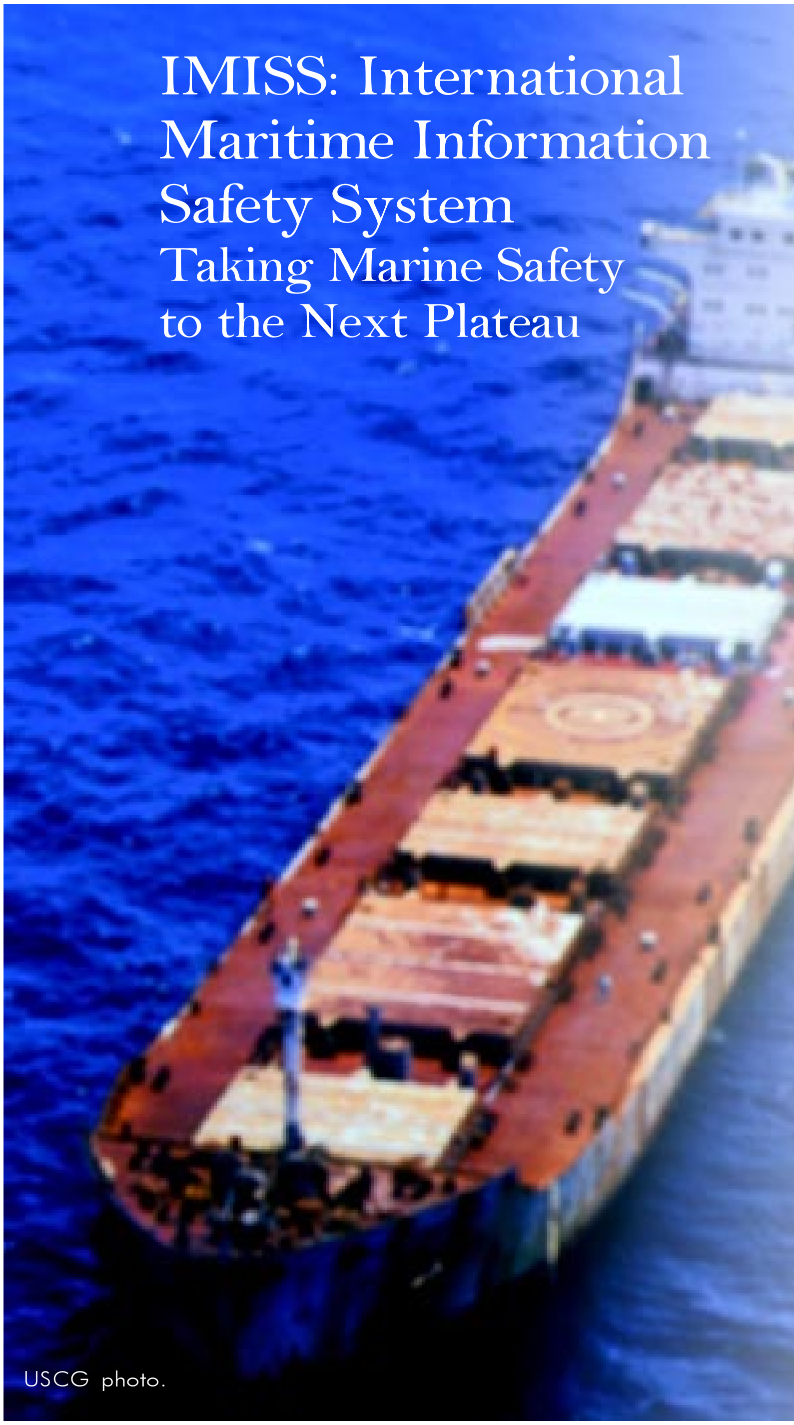
From the outset, our mariners have played a key role in the integration and implementation of these systems. To achieve our goal of zero incidents, our mariners aboard ship must be an integral part of key initiatives. At the time our EHSMS initiative was first being introduced, we were also implementing the International Safety Management (ISM) Code throughout our worldwide fleets. Since there were many similarities, we found that it was possible to dovetail many of the ISM initiatives with our EHSMS.

The measure of any safety initiative is ultimately determined by results—and so far, the results are encouraging. Our record with respect to prevention of spills and major incidents continues to be excellent. Compared to 1992, our number of lost time incidents per million man-hours improved by an additional 40% in 1997 and 80% in 1998. We are convinced that our goal of zero incidents is achievable and that aggressive application of systematic measures to identify, reduce, control and manage potential risks can help achieve that goal.

Risks will always exist, but they can be effectively managed if the key factors involved are systematically evaluated and addressed. Mobil's EHSMS provides a structure that delivers on this objective and is helping us continue to achieve strong safety, health and environmental performance.

IMISS: International Maritime Information Safety System

Taking Marine Safety to the Next Plateau



USCG photo.

By CDR Scott J. Ferguson, Officer of Investigations and Analysis, USCG, Alexander C. Landsburg, Program Manager for Systems Safety and Human Factors, and Glen C. Kraatz, former Coordinator, Government & Public Affairs for Chevron Shipping, retired

Concept

The Coast Guard, Maritime Administration, and industry have been working together over the last year and a half to put the International Maritime Information Safety System (IMISS) in place. The IMISS project is the development of a voluntary non-attribution national/international maritime safety trend and lessons-learned system. Though the marine community captures much information on marine casualties, there are many more situations that involve unsafe occurrences, such as near-accidents and hazardous situations involving vessels, their crews, and/or passengers and cargo that go undetected. The intent of the system is to capture this material that, but for some preventive action in the chain of events, did not result in the occurrence of an accident.

The reporting system will allow the maritime community to identify system vulnerabilities and weaknesses well before failures or accidents occur. Implementation of this system will provide a valuable source of data for use in risk-based approaches to safety in two manners. First, it will allow capture of a large volume of data (that would otherwise be unavailable) characterizing how things go awry in the maritime industry. Indeed, studies by Dr. James Reason of the University of Manchester and Dr. Jens Rasmussen of the Technical University of Denmark have shown that for every accident (captured in the MSIS database), there are as many as 300 near-accident situations that go unrecorded. Second, this data provides insights on how these incidents were kept from turning into accidents. This provides valuable information for managing safety, by showing how the maritime system (including the human element) is able to deal with emerging situations and return them to a safe state.

Benefits

The knowledge gained from a systematic analysis of near-misses and hazardous situations is extremely advantageous. The system will point the way to key interventions that should reduce the number of future casualties and injuries, mitigate damage to the environment, and lower operational and response costs for both the private and public segments of the maritime community. Preventing just one major event involving a large loss of life and/or damage to the marine environment could result in cost savings for the maritime community and the general public in billions of dollars. The day to day cost savings for the maritime community from the reduction of marine casualties and oil spills, cargo claims, insurance premiums, and seaman and employee injury claims is potentially in the hundreds of millions of dollars. The proposed system is an excellent future candidate for the Secretary's "ONE DOT" management strategy to expand the concept to include marine, air, rail, pipeline, and highways all within one safety incident reporting scheme.

Scope

The estimated cost to operate IMISS on a reoccurring annual basis ranges between $650,000 and $3,000,000 a year, depending on the organization and size of the system's operation. With time, it is desired that IMISS will be at least partially self-sustaining, offsetting its yearly operating cost through possible membership fees, subscriptions, or other revenue-generating activities.

It is recommended that IMISS be sponsored by a Federal Government agency, managed by a separate non-regulatory agency and operated by an independent commercial vendor/contractor. This would be similar to the model successfully established by the airline industry, where the Federal Aviation Administration is the sponsoring agency, the National Aeronautics and Space Administration is the managing agency and Battelle Corporation is the Aviation Safety Reporting System (ASRS) operations center contractor.

IMISS will be an evolving system, and as it matures and gains recognition within the global maritime community, its focus will be expanded. During the initial operating phase, the system will focus on U. S. commercial vessels and international ship traffic in U. S. waters. This will expand as the system matures to encompass most, if not all, of the maritime industry. However, IMISS will not preclude reports from any source on any maritime safety issue anywhere in the world.

USCG photo.

Confidentiality

To address confidentiality issues, a draft legislative amendment has been developed to preclude the use of IMISS input reports, data, or output from being used in civil, criminal, or administrative actions, or referenced in establishing any industry customs or practices for litigation purposes. All reports and information included in IMISS will be de-identified so it cannot be traced back to the reporting parties, involved companies, or any other entities referenced in the reports. The system will be based on anonymous reporting with an *option* for callback. IMISS liability protection will not eliminate the need to comply with notification, report, documentation, or all other requirements stipulated by law or regulation, nor will any of these existing requirements be protected under the IMISS legislative amendment.

The reporting system will allow the maritime community to identify system vulnerabilities and weaknesses well before failures or accidents occur.

IMISS Input

There will be few definitional restrictions placed on the type of information an individual could report to IMISS. Observations, potential hazards, procedural problems, system deficiencies, barely avoided accidents, and improvement suggestions are all seen as appropriate inputs. There will be no restrictions as to who may file an IMISS report. Ships' officers and crew, shoreside personnel, pilots, pleasure craft operators, marine related government employees, shipyard workers, offshore industry personnel, and private citizen observers are all potential input sources.

Reporting

Electronic, paper, and phone reports will be accepted without attribution and entered into a standard database by the center's personnel. The IMISS Data Center will then organize and categorize the deidentified incoming information, looking for trends, dangerous situations, lessons for future learning, and recommendations for government or private prevention actions. All submitted report forms, either paper or electronic, will be destroyed after being processed by the Data Center. No files are to be retained of the report forms themselves and no records are to be kept of mailing lists or contact information of those who sent in reports.

Layout: The data form must be simple and clear (see Sample Report Form on page 30 as example).

Form: The basic report form should fit on two sides of a single sheet of paper. It should also be available over the Internet and printable by a novice computer user. No training should be necessary to successfully complete the form.

Content:

• Basic situational information should be included for check-off or fill-in to permit easy categorizing into different major file groups. The form may offer suggestions on what to include in the narrative sections. This could include key words so that reported information can be more effectively handled by the Data Center. Basic instructions should be provided with the form, such as asking the reporter to indicate "what happened," "why it happened," "what went wrong," "what prevented it from being worse," and "how the situation might be avoided in the future."

• There should be a prominent statement on the form warning individuals that an IMISS submission is not a substitute for handling reportable incidents under standing laws or regulations. Information reported to IMISS also does not eliminate any International Safety Management (ISM) Code reporting requirements, and that should be indicated.

• Initially, identification of the individual reporting will not be requested on the form. A toll-free telephone number should be included on the form to encourage individuals to call in a report. Callback capability will be initiated in a later phase.

USCG photo.

IMISS Output

A variety of output products will be used by IMISS, each dependent on the urgency surrounding the collected information and the different needs of various recipients. It is envisioned that the exact output formats will evolve with time. Furthermore, requests to search the IMISS database will be entertained by the center to accommodate the needs of government, academia, and private industry.

Postscript

All readers are encouraged to help with further development of IMISS. Information presented here requires tweaking and detailing and your thoughts for developing the best possible workable system are requested. For further details, please visit our web site at **http://www.uscg.mil/hq/g-m/moa/nearm.htm**. Please forward any ideas, comments, insights, or offer to participate actively in the process to any of the following:

Mr. Glen C. Kraatz, 2 Kulani Lane, Pleasant Hill, CA 94523; (925) 256-6572

Mr. Alexander C. Landsburg, U.S. Maritime Administration, MAR-250, Room 7302, 400 Seventh St. SW, Washington , DC 20590; (202) 366-1923, Fax: (202) 493-2288, e-mail: alex.landsburg@marad.dot.gov

CDR Scott J. Ferguson, U.S. Coast Guard, Commandant (G-MOA), Officer of Investigations and Analysis, U.S. Coast Guard Headquarters, 2100 Second Street SW, Washington, DC 20593-0001; (202) 267-0715/1430, Fax: (202) 267-1416, e-mail: sferguson@comdt.uscg.mil

Disclaimer

Note: The views expressed herein are those of the authors and are not to be construed as official or reflecting the views of the authors' respective organizations.

SAMPLE REPORT FORM

IMISS Report Form Questions

This report is about a(n):

- ❑ Suggestion / Good Idea / Lesson Learned
- ❑ Potential Hazard / Deficiency
- ❑ Incident (near miss, non-normal event)
- ❑ Observation / Other ______________________

Tell us about yourself.

1. What is your role in the maritime industry?

- ❑ commercial mariner or marine pilot
- ❑ government mariner (Navy, NOAA, etc.)
- ❑ off-shore platform worker
- ❑ dock worker or terminal worker
- ❑ worker on other marine facility or structure ___________________
- ❑ shipping company employee
- ❑ other shoreside ______________________________
- ❑ passenger
- ❑ recreational boater
- ❑ non-maritime / observer
- ❑ other _____________________________

2. What is your specific job (rank, department, etc.)?

3. Type of vessel / facility / structure where you typically work?

Suggestions, Observations, Hazards, etc.

Got a good idea? Know about a safety hazard?
Want to share something you've learned? Or just want to gripe?

All comments are welcome!

Please write your comment below. Please be as specific as possible about the situation involved. To what vessels / facilities / waterways / operations does it apply? What types of procedures / policies / equipment are involved? Thank you for taking the time to comment.

Page 2 to Sample Report Form:
Incident / Near Miss / Non-Normal Event

1. Type of incident
- ❑ near collision
- ❑ near pollution
- ❑ near allision
- ❑ near fire
- ❑ near explosion
- ❑ near injury
- ❑ near grounding
- ❑ near loss of vessel control
- ❑ other ______________________________

2. When did the incident occur? Date: ______________
Time: ____________ am/pm

3. How were you involved in the incident?
- ❑ directly involved—I was an active participant.
- ❑ indirectly involved—I was at the scene, and saw/heard everything that happened.
- ❑ observed from a distance—I did not see/hear everything.
- ❑ not involved—I heard about this from someone else.
- ❑ other ______________________________

4. Type of vessels, platforms, structures, or facilities involved:

5. Where did it happen? (specify the waterway, port, location on ship, etc.):

6. What was happening at the time of the incident? What specific operations were going on?

7. Describe what happened. What were the events which led up to the problem? How was the problem discovered? What happened next?

8. What do you think caused the incident? (Consider: judgements; decisions; actions; inactions; perceptions; communication; attention; memory; information overload; fatigue; drugs or alcohol; physical or mental condition; procedures; policies; regulations; design of equipment / ship / facility / waterway; adequacy of crew / workers [training, experience, number]; weather; visibility; equipment failure [why did it fail?]; maintenance.)

9. What went right? How was an accident avoided? *(Consider: corrective actions; contingency plans; emergency procedures; luck.)*

10. How can we prevent similar incidents? What changes need to be made? By whom?

RISK MANAGEMENT: A MARINE UNDERWRITER'S PERSPECTIVE

By William H. Moore, Dr. Eng. Director, Risk Management, Storebrand Vesta Marine & Energy Insurance A/B

This article demonstrates the interest that the insurance industry is giving to risk-based approaches, and describes how one insurance company has successfully implemented risk management. Like the previous article on the International Maritime Information Safety System, this article discusses how the insurance company identified the need to collect additional data on near misses, and developed a safety and improvement reporting system for their clients.

Introduction

Shipowners and shipmanagers are exposed to a variety of risks that includes technical, operational, management, market, and financial elements. Regulatory changes, global market competition, financial liquidity, acquiring competent crews, safety, and quality management are some of the risks that need proper consideration. To gain a competitive edge, there is a growing need to protect the services provided to customers through *enterprise risk management*. Enterprise risk management approaches are used to identify, assess, and manage multi-dimensional risk exposure.

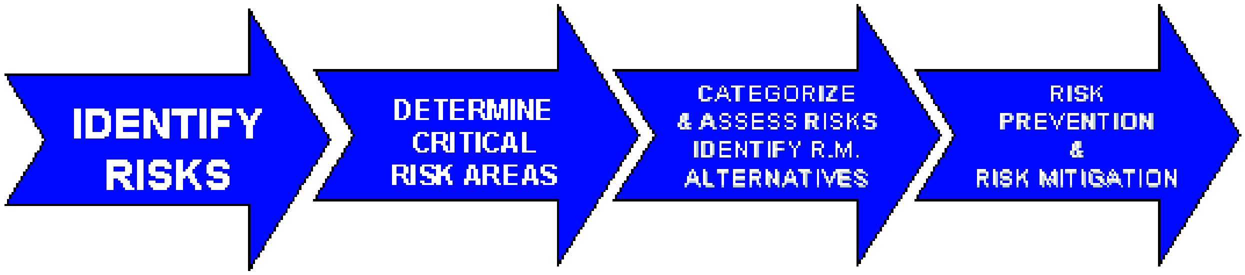
There are means to protect against risk exposures through marine insurance products and value-added tools. This requires that marine insurers reassess their traditional roles in the maritime industry by developing expertise to assist their clients in managing their risks. This includes developing technical, management, financial, safety, and operational expertise that can lead to the development of innovative tools that protect the assured and the insurer.

Background

Storebrand Vesta Marine & Energy Insurance A/B (SVM) is a new corporation founded as a merger of the marine and energy divisions of two major underwriters in Norway: Vesta and Storebrand. SVM underwrites a well-balanced portfolio with a marked presence in most of the world's shipping and energy centers; it is the second largest hull and machinery underwriters in the world, accounting for six percent of the global market.

SVM has developed an enterprise risk management strategy to assist clients with services and tools to manage safety and quality at sea. Currently, insurers are not in a position to affect certain types of risks such as global markets and financing. However, insurers are in a position to protect organizations from particular types of risks through standard and tailor-made insurance products, business support, and risk management tools and services.

Figure 1: Modules of Risk Management Process.



The Risk Management Process

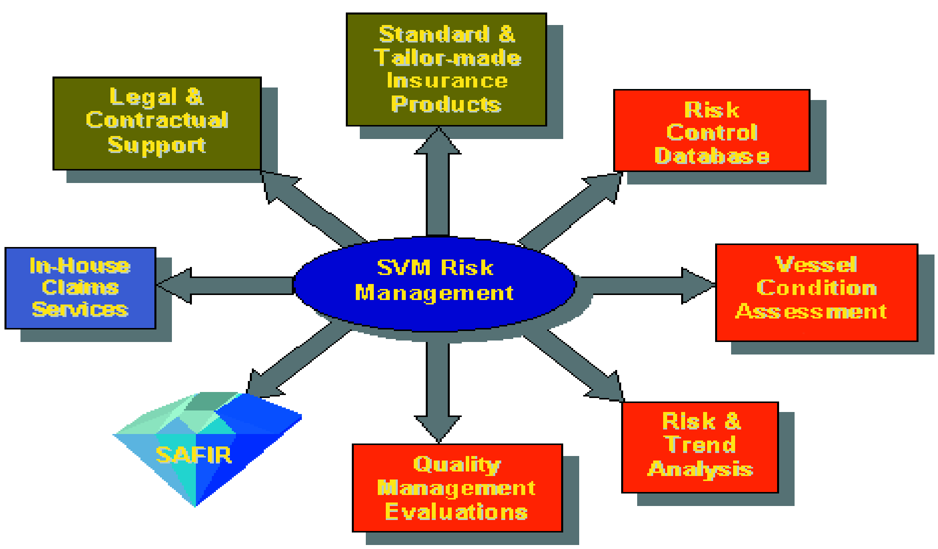
SVM applies the four-step risk management process as shown in Figure 1. These steps are: (1) identifying risks; (2) determining critical risks; (3) categorizing and assessing risks, along with identifying risk management alternatives; and (4) preventing and mitigating risk.

The first step is to identify risks to our clients. These risks include factors such as market competition, financial liquidity, operations, safety and quality, crew competency, and other risk elements. A determination of the critical risk areas and an assessment of their effects are then performed with the SVM Risk Control Tool. This tool is used to categorize risk factors.

Risk Prevention and Mitigation

Once critical risks have been identified and assessed, a number of tools and services are applied to manage the shipowner's and ship manager's exposure to critical risks (see Figure 2). These include traditional insurance services such as standard insurance products and in-house claims services. In this manner, the insurance industry helps spread the financial risk. However, a number of risk management activities are also available in support of these services and provide further management of risk. These alternative/additional risk management tools help to reduce the risk to acceptable levels. For example, clients may identify other risk areas that may not be covered by these plans and particular clauses can be prepared to protect against these risks (e.g. long-term fixed price contracts, specific Force Majeure clauses, millennium clauses, etc.).

Figure 2: Risk management through a variety of tools and services.



The SAFety and Improvement Reporting (SAFIR) system

In addition to the traditional insurance mechanisms, SVM has developed a service for clients much along the lines of the aviation community's Aviation Safety Reporting System. This maritime equivalent, SAFIR, has been operational since 1995. SAFIR has been developed and tailor-made especially for the shipping industry to meet the safety requirements of section 9 of the ISM Code and support ISO 9000 and 14000 certification. The SAFIR system serves as a valuable tool for shipping companies in their continuous work on safety and quality improvements. The system captures information on human factors and safety management, and provides the framework to perform formal safety assessments. There are currently 50 companies worldwide using SAFIR with a total fleet of 1,500 ships.

The Safety module of SAFIR handles accident, near-accident, and non-conformity reports (see Figure 3). The Quality module handles inspection reports, customer remarks, and suggestions. The two modules operate together when a quality report identifies a safety-related event. For example, when non-conformities are uncovered during an inspection, the system launches the report, which then enables the user to analyze the cause of the event and work out an action plan to prevent such events in the future.

SAFIR provides our clients with the unique ability to capture cost and off-hire for any event with a particular consequence (e.g. medical expenses, loss of working ability, deviation cost, vessel damage, cargo, environmental damage, third party liability, and/or loss of hire). Proper monitoring of these expenses shows the actual cost of accidents, near

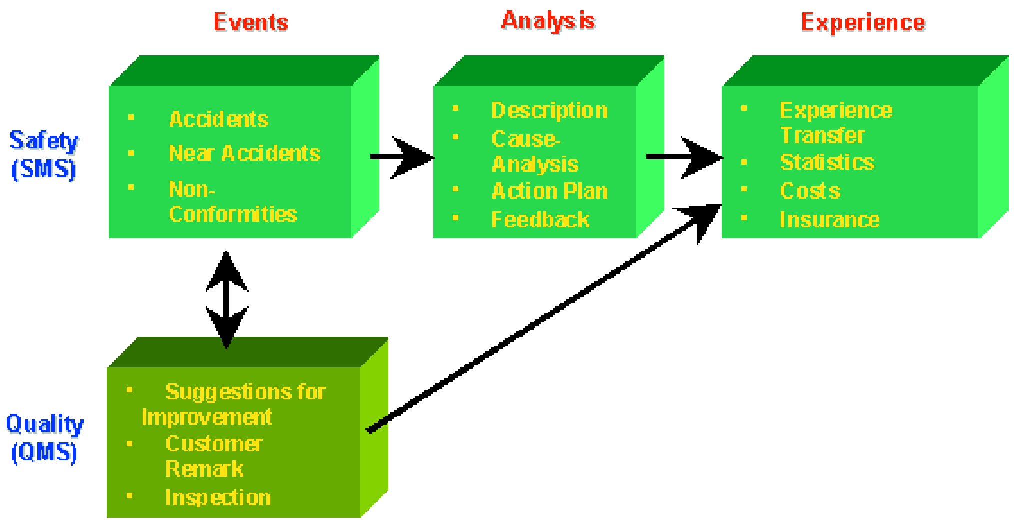


Figure 3: SAFIR Safety and Quality management process.

misses and non-conformities. SAFIR provides operators with a system to identify, assess, and develop strategies as to where to invest limited quality and safety resources to maximize returns.

Quality Management Evaluations (QME)

The main purpose of a QME is to enable us to assess the risks that we insure. Detailed knowledge about the operating standards of the organization and information about the vessels gives us the opportunity to differentiate premiums more accurately. However, we also see a management evaluation as a way of getting to know our clients better and of building a cooperative relationship. Furthermore, if we act as the claims leader, it is essential that we know and understand the client's organization in order to provide the service that we have promised. Primarily the time is spent meeting and interviewing one senior member from the staff of each department (for example, crewing, purchasing, safety & quality, technical department, insurance, operations, and chartering).

Risk and Trend Analysis

To manage our enterprise risk, SVM utilizes a wide range of information technology and industry data to evaluate risks. The risk and trend analysis allows us to provide information directly to our clients and determine our own risks in underwriting. SVM tracks information from both marine insurance and industry sources on claims, casualties, human factors, risk analyses, shipping, and global market trends to provide us this monitoring capability.

Vessel Condition Assessment (VCA)

Vessel condition assessments have been part of the risk management strategies for most marine insurers. SVM performs VCAs at the request of our underwriters and claims departments. In addition, we perform VCAs at the request of a client independently from the underwriting and claims activity. Personnel performing VCAs are qualified in operations, technical, and ship management and are able to provide insights to risk control that are independent of class or statutory surveys, inspections, and audits. Such a process provides a valuable supplement to the risk and trend analysis function by providing real time assessments of the vessel risk.

Summary

The role of the marine underwriter is evolving to consider risk in a holistic sense. Storebrand Vesta Marine Insurance A/B considers its risk management tools and services as value-added services to its clients. Through enterprise risk management and the evaluation of holistic risk exposure, SVM assists its clients in controlling their risks. This leads to better results for both the insurer and the assured. This partnership between the client and SVM is just good business sense.

Risk-Based Decision Making in the Field

Risk-based decision-making is a concept that can be applied in many different ways, through many different means, with many different outcomes. The overarching commonality of these varied risk-based decision-making concepts is the purpose—to improve an element of safety. It is this element that we focus on with this article. What follows is a compendium of risk activities that are taking place in the field. Each of the four MSOs presented here share their experiences of how they've successfully applied risk-based decision-making principles. Though each story is particular to that MSO, it is presented in the hopes that others will be able to find the information useful and be able to modify it for their own needs.

MSO DETROIT

Business Planning with Risk Assessments

By CDR William Diehl, Executive Officer

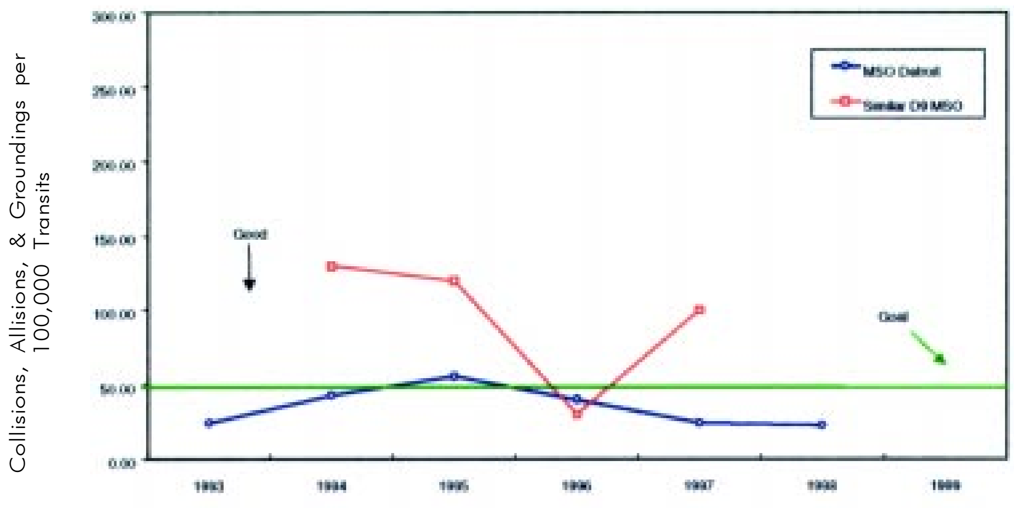
At Marine Safety Office Detroit, we build our risk assessment into our business planning process. Each year we produce a Business Plan that serves as a blueprint for the activities during the coming year. This Business Plan effectively directs unit resources to address all strategic goals. We view our risk assessment approach as a tool to consistently make correct decisions that are aligned with our strategic and long-range plans.

We started implementing a risk assessment into the Business Plan in 1995 when the vessel casualties in our Area of Responsibility (AOR) were on an unacceptable upward trend (see Figure 1). The results were immediate, and the trend immediately reversed and has continued to decline successfully.

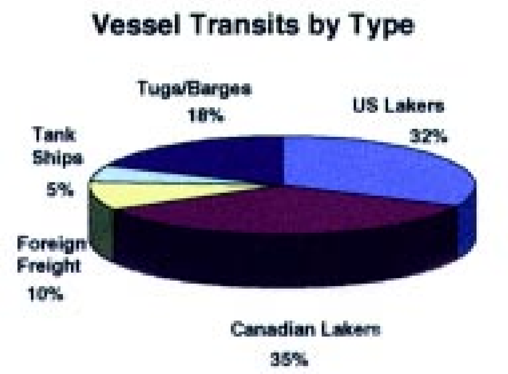
How does this work? Our risk assessment is part quantitative, based on measurements, and part qualitative, based on personal experience. Our decisions are based on data and knowledge. First our goal as a field unit is to advance the efforts of the Commandant, more specifically the Marine Safety and Environmental Protection (G-M) Performance Plan. G-M charges us with saving lives, preventing casualties, facilitating commerce and protecting the environment. So for our quantitative part we don't create new measures; we simply look at the G-M's goals and measure our performance relative to those goals. What this gives us is a unifying measurement framework based on shared philosophy, common terminology, and a commonly understood method of collecting and analyzing the same data. There's no mystery to this approach; it's a simple and repeatable process. For the most part, data is developed from our own historical records and the Coast Guard Marine Safety Information System (MSIS). We then combine the data and present the results in a segmented format.

The figures shown are examples of how we display the information, so we can market it along with our initiatives to our customers, partners, and crew. We've found that this type of information is more easily understood and effective when displayed in charts (as opposed to lengthy, complex documents). We develop the charts from our casualty statistics as seen in Figure 1.

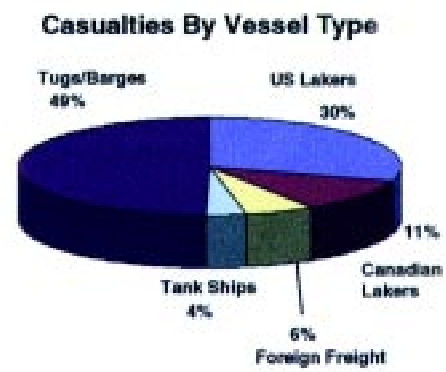
Vessel Casualties in Detroit AOR



Then we compare the vessel transits by vessel type with the casualties by vessel type. In this example we found that tugs and barges, while only 18% of the vessel transits, were involved in 49% of the casualties. Then we look at the breakdown of the causes of the casualties. It simply shows the statistics without making judgement calls or interpretations of any sort. We present this information to industry through MSO Detroit's "Waterway User Group." Meetings with this group are held twice a year and topics include issues of the waterfront, such as potential impacts of upcoming projects or new traffic patterns. It's a very effective process for bringing all parties within the AOR together.



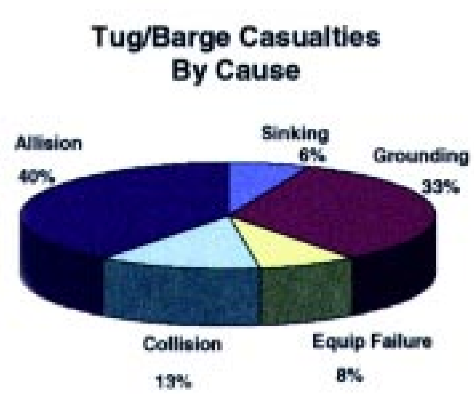
The second step of the risk analysis is the qualitative part, which is based on our collective unit judgment as to what are the most possible or probable incidents that might occur in our AOR. The Quality Management Board (QMB) members drive this process. The QMB at MSO Detroit consists of the Commanding Officer (CO), the Executive Officer (XO), Senior Reserve Officer, Senior Auxiliary Officer, Department Heads, Command Enlisted Advisor, and a Reserve enlisted member. Using the measurements discussed previously and input from the crew, two questions are answered by the QMB:



1. What are the catastrophic, no advance notice events that are likely to occur in our AOR?

2. What are the high-risk operational problem areas in the AOR?

This year nine areas were identified, including Y2K disruptions; a serious hazardous chemical incident in Sarina, Canada; and a foreign vessel fire.



As you can see, our risk assessment method is simple—measurements coupled with our projected probabilistic worst case scenarios. This approach improves our planning which, in turn, improves readiness. It's a tool each unit can use to assess its current readiness condition and to identify areas for improvement. We keep it simple and link it back to program goals.

Port Risk Analysis from the Maritime Industry

By LT Anthony D. Morris, Assist. Senior Investigations Officer

In a desire to focus harbor safety efforts, the Prevention Through People (PTP) subcommittee of the San Francisco Harbor Safety Committee has embarked on a mission to develop a Port Risk Assessment questionnaire. The basis for the questionnaire is to survey the local maritime community on what they perceive to be significant risks that effect operation within San Francisco Bay. This project is part of a major partnership outreach effort designed to obtain maximum industry input, while effectively using limited personnel and financial resources.

The subcommittee started out in the developmental phase of the survey by asking the question, "What do we hope to accomplish with this survey?" As simplistic as this question reads, several hours were used to outline the answer to the question and to focus on the various categories of risk analysis. Actual marine casualty data, local knowledge gleaned from various subcommittee members, and good common sense were used as guidelines to help answer this question. An outline format was used, and the taxonomy developed within the outline of the survey focused on four main areas of concern.

The first category involves basic communications. Within this category subtopics such as language, interagency/organization communications, and recreational versus commercial vessel communications are identified as potential risks within the Port. The second category involves fatigue with a focus on the interpretation of current regulation and how they affect work versus rest hours. The third category is crisis management; this focuses on contingency planning, scenario planning, and drills. The effect of crisis management is directly linked to how well government and industry officials are prepared to handle significant events in partnership, and the survey solicits input on identifying areas that pose the most potential problems. The fourth and final category focuses on training and crew competence. This category explores general job satisfaction, and how well individuals know their jobs and understand the regulations governing them.

A test survey will be mailed out to a small representative group to help refine the questions and the survey format. Once this has been completed, the final survey will be distributed to the commercial industry, the recreational boating public, and government officials. The surveys will be analyzed and measured against those risks outlined in the latest waterways and management study, as well as the empirical data charted within unit casualty analysis documents. From the survey, the Captain of the Port, commercial and recreational interests, and regulators will have a working risk analysis document that will highlight common risk concerns and build a framework to jointly evaluate options to reduce or eliminate those risks.

The key benefit will be the ability to definitively state what our major risks are in the Port of San Francisco. Armed with this information, the San Francisco Bay Harbor Safety Committee will be able to better allocate limited financial and personnel resources to reduce or eliminate the identified risks. The questionnaire will be the foundation for a strong Risk Assessment document designed to set a working agenda for the next millennium.

MSO SAN FRANCISCO BAY

Looking at the Risks of a Fast Ferry System in the San Francisco Bay Area

By LCDR Marc Nguyen, Compliance and Analysis Section Chief (PACAREA/D11)

In another application area, MSO San Francisco personnel have engaged in an effort to proactively address an effort to deal with increased highway congestion in the San Francisco Bay area. According to the U.S. Bureau of Census, California's population growth is predicted to continue unabated through 2025. It is expected to be the fastest growing state between 1995 and 2025, adding 17.7 million people to its population (an increase of 56%). By the year 2020, traffic congestion is projected to increase by 250% percent in the San Francisco Bay Area. Currently, the Metropolitan Transportation Commission estimates that San Francisco Bay Area drivers are wasting 90,000 hours a day with motors idling on gridlocked highways during commute times. It also costs businesses $814,000 daily in lost productivity. As roads and bridges clog up and bus and rail systems progressively reach maximum capacity, traffic analysts say rush hours will be replaced by daytime-long traffic delays, with average speeds dipping from about 30 mph today to as low as 15.8 mph.

Faced with these unappealing statistics, Bay Area leaders are aggressively pursuing a "High-Speed/High-Capacity Ferry" transit system on San Francisco Bay. The 52-member task force calculates that this "fast ferry" system would attract 40 to 50 million passengers a year, the equivalent of a four-lane freeway. When implemented, this system would have a fleet of 125 high-speed passenger and freight ferries docking at 40 terminals all around the bay. These vessels would travel at speeds up to 40 knots, and provide service at least 16 hours a day.

Safety risks on the Bay will increase significantly as traffic shifts from highways to the waterways. These high-speed craft will compete for navigation space occupied by a growing number of commercial ships and recreational boats, thereby increasing the likelihood of accidents such as collisions. Further influencing the risk of this hazard are issues such as the speed of the fast ferries, routine operations in fog in the bay area, and conflicting operations with ferry routes crossing traffic separation schemes. In addition, having a large number of passengers moving about the bay will increase the potential consequence of an accident should one occur, as well as tax the search and rescue resources which might mitigate these consequences.

Effective waterway management is one of many factors that help reduce maritime risk. Although Vessel Traffic Service (VTS) San Francisco is minimizing the risk of collision by monitoring and evaluating vessel traffic, the current level of service will not be adequate to meet the expected demands over the next 10 years. We will have to rely on technology and safety initiatives to continue effective waterways management. In place currently are risk reducing measures such as Aids to Navigation (AToN), traffic lanes, and regulatory requirements for design, operation, and maintenance of vessels. However, these measures alone will not be enough to effectively meet the safety requirements in the future. Ports must not only be ready to meet the safety requirements but also be prepared to respond to a serious marine casualty.

To address this emerging risk, we will have to better leverage existing resources, and incorporate potential new resources such as high capacity Search and Rescue platforms through use of a risk-based approach. Only by proactively managing risk in conjunction with port area stakeholders can we ensure that adequate safety levels are maintained in this effort to reduce gridlock. MSO San Francisco is currently developing a process to work with the port community to evaluate the rising risk and potential options that will keep it within acceptable limits.

MSO BOSTON

Managing the Risks Associated with Small Passenger Vessel Operations in the Port of Boston

By CDR Mark Skordinski, Executive Officer, MSO Boston

A systematic and accurate risk assessment is the first step toward success in preparedness and response. You cannot adequately plan for something unless you've first examined what "bad things" could happen in your area of responsibility. With the revitalization of Boston Harbor and the traffic woes created by the "Big Dig" (a massive $10 billion public works project to relocate the city's main surface arteries underground), the public has increasingly looked to water transportation for both recreational and commuting purposes. The proliferation of watercraft (including high-speed passenger catamarans) in the fairly restricted confines of Boston Harbor, coupled with several small passenger vessel fires, quickly defined our "bad thing."

To address this issue, we assembled a workgroup of stakeholders who have a direct interest in making water transportation a safe and viable alternative. Our stakeholders included local port authorities (harbormasters, fire department, State Police marine unit), municipal transit authority, small passenger vessel owners/operators, yacht club representatives, as well as waterfront homeowners who were concerned about property erosion through wake action. Stakeholder participation is critical to the success of any risk management program. Most of the knowledge of risk lies with the people closest to the process. Although this sounds obvious, many past risk management efforts have been done through a "regulator/regulatee" relationship rather than the more desirable cooperative partnership promoted by the Prevention Through People (PTP) initiative.

PTP guidelines formed the basis of our risk management project. Through the use of a systems approach to human element risk analysis as contained in Appendix I to the PTP Quality Action Team's Final Report, our first step was to develop a functional flow block diagram—a flowchart—of the steps involved in safely moving people from point A to point B. We recognized that all risks are not created equal. Therefore, using the expert opinion of the stakeholders, we identified those steps considered to pose the greatest risk and then jointly developed and analyzed realistic, credible casualty scenarios for each high-risk block. Analysis of these scenarios included identification of the root causes (apparent, propagating and originating), development of countermeasures with their associated cost, and an evaluation of the risk control potential for each countermeasure.

As you can imagine, the development and analyses of these casualty scenarios was the phase of the risk management project where the "rubber met the road." While our potential countermeasures didn't have the force of regulation behind them, they made all participants look at their respective operations in a different light. By raising the participants' hazard awareness of what could go wrong and more importantly, encouraging "out of the box" thinking in how to deal with a risk, the safety posture of the operating small passenger vessel fleet in the Port of Boston has been significantly enhanced.

A significant collateral benefit of this entire process was opening the lines of communication between all involved and especially between the recreational boaters and homeowners and the commuter ferry operators. Where, prior to the start of this project, we received up to 10 complaints per week against the commuter boat operators, the number of subsequent complaints has since dropped to virtually zero.

In order to make risk assessment part of a successful planning effort, it must be accomplished systematically. The following steps are fundamental to the risk assessment process and should be included in each case. How these steps are accomplished will vary depending upon the risks, issues, and preferences of the stakeholder group.

Establish goals and objectives. Why are you assessing risk? Articulating the fundamental purpose of the assessment process is critical to success, and therefore must be shared and understood by all involved.

Identify stakeholders. Gathering the appropriate stakeholders is the single most important step in the entire risk management process. Without the proper mix of people, crucial risks may not be considered and "buy in" by those most affected by any recommended preventative actions will be tenuous, at best.

Use a structured risk management process. Risks that fail to be foreseen lead to unpredictable losses or casualties. Use of a systematic, repeatable process allows you to establish credibility and ensure that all reasonable risks have been considered.

While our formal Passenger Vessel Risk Management project has come to an end, we plan to continue meeting with stakeholders on a regular basis to maintain the level of cooperation currently enjoyed and address any new concerns that may arise. Through the use of a structured risk management program, shared use of the waters of Boston Harbor can continue to safely grow well into the next millennium.

MSO CHARLESTON

Risk Application at the MSO

By LCDR Alan Marsilio, Executive Officer

MSO Charleston recognizes the vast benefits that are gained by applying these to many of our key initiatives, most prominently with our Marine Fire Fighting and Unit Activities. By taking a proactive role and addressing the various risk issues associated with these initiatives, we are creating awareness and a safety mentality, as well as making the best use of our available resources.

Marine Fire Fighting: The Marine Fire Fighting Committee of the Port of Charleston, a group of local industry representatives, emergency responders, and MSO Charleston, has been mounting an intensive campaign to improve the response capability for the port.

The committee began its work with a **hazard analysis**—a study of the potential for damage caused by fire and associated disasters in the marine environment. The Hazard Analysis Sub-Committee systematically evaluated all of the port's waterfront facilities and vessel types through a questionnaire that was distributed to terminal operators and data that was compiled by the MSO and the Pilot's Association. This approach enabled the sub-committee to outline where the potential hazards lie within the Port of Charleston.

The second step in the study was to complete a **risk analysis**—a study of the probability of an incident occurring that would cause damage to life, property or the environment. The Risk Analysis subcommittee turned to sources that included Industrial Risk Insurers' *Exposure & Protection Check List*, *The Standard Building Code 1997*, and the *National Fire Protection Association Publication 704*. The subcommittee was able to devise a 'rating scale' that could be applied to the data collected in the hazard analysis.

The third step was a **vulnerability analysis**—a study of the susceptibility of life, property and the environment to injury or damage caused by fire or associated disasters. Typically, this analysis must account not only for the damage likely to be wrought by a fire, but also whether responders can quickly and effectively access the fire to extinguish it.

The three-step analysis brought out one glaring area in which the Port of Charleston is vulnerable when facing a marine fire: fighting a fire on a ship, especially involving hazardous materials. The port's shore-based fire fighters lack the training, equipment, and waterborne platform needed to effectively fight a shipboard fire at sea or at anchor.

This three-step analysis process was instrumental in securing for the port an infusion of federal funds from the U.S. Department of Transportation for a major new fire fighter training program. A total of 76 fire fighters and supervisors will be trained in 1999 at the Maritime Administration's Great Lakes training center. This, along with local matching funds for training and equipment secured through concerted efforts of the entire committee, will ensure the beginnings of a complete, professional, and effective

Table 1.

	MSO CHARLESTON UNIT GOAL/AOR RISK ALIGNMENT					
UNIT GOAL/ACTIVITY	**TRAINING DEVELOPMENT**	**PREVENTION**	**RESPONSE**	**QUALITY OF LIFE**	**ORG/TECH IMP**	**OUTREACH**
HURRICANE IMPACT	All hands preseason Chastn EPD training Annual HURREX	Port assessments Container stack plans PCIB, BNTM, PreSeason mtgs MARAD mooring plan review	Hurrex Plan update Post storm surveys Man EOC, Comms	Shelter Research PREP Brochures/ Matl's	Rev/Improve Plan fm lessons learned Helo support, Internet tracking	PCIB, Newsletter Distrib Plan LEPC, Advise Pilots & Harbor master
FISHING VESSEL SAFETY	CG Stations BO Training Training aids	CFVS Civil penalties TAD/ADT	INV marine cas Pol Response Helo flts	Dedicated GV Recognize high perform SWP	F/V QAT w/ GRU/STA Res Aug, TAD, IR	Hospital visits, NMFS public mtgs, Air/Sea rescue demos/trng
DEEP DRAFT VESSEL INHERENT RISK	REC course - Port State trng Resident trng process MI/BO PQS - Unit trng	MM Lic Prog MI & Port State Progs Brochure, UKC Prog Inv, Civil Pen/S&R	INV marine cas COTP Order Public Complaints INV Ltrs of Dev, MI	SOHC SWP/Equip Reserve int/Team CG OMMP	Port State Res use MMLD, IR, Pilot fax scheds	MAPCHA, PCIB Newsletter, CC Intermodal

response capability where virtually none existed merely months before.

Risk-based Assessment of Unit Activities: In 1996, MSO Charleston's Quality Management Board (QMB) set about the task of applying some form of risk-based assessment of daily mission activities to improve the unit's efficiency and effectiveness. The QMB adapted MSO Savannah's Unit Risk Matrix to MSO Charleston's Area of Responsibility (AOR) and, additionally, took the further step of aligning the risk matrix with the six unit goals developed by the QMB the year before as part of the unit's Continuous Improvement Plan. The result is a matrix of risk activities tied to goals via the MSO's tools used to address them. An excerpt of the matrix is shown in Table 1.

Across the matrix's top are the six unit goals: Training, Prevention, Response, Quality of Life, Organizational & Technological Improvement, and Outreach. Along the matrix's side are 23 activities identified by the QMB as constituting the entire range of risks in the AOR, from natural disasters to the impacts of port and waterway development on the environment and on safe navigation. The activities are arranged in descending order of perceived risk based on subjective evaluation and historical data. Within the body of the matrix are assigned all of the tools used by the MSO to address the activities as they

Downtown and the port of Charleston are located on the banks of the Cooper River.

align with the unit's goals. For instance, the MSO uses annual seminars produced by local emergency response agencies to enhance personnel training, (a unit goal) to prepare for mitigating the effects of hurricane impact (a risk activity). After completing the matrix with all of the unit's tools, gaps were easily identified where insufficient tools existed to address particular activities or goals, or where the use of tools could be better realigned with higher risk activities. The gaps and realignment needs were then incorporated back in the Continuous Improvement Plan in a feedback loop to revise the unit's blueprint for continuous improvement. Future plans for the risk matrix, a living document, are to incorporate more and better risk measurement schemes to further validate or revise the relative risk ranking of the 23 activities.

Risk-Based Decision Making in the Field

The examples presented show how risk-based decision-making can be used to improve effectiveness and safety in a wide variety of areas. The key to achieving these successes is clear: teamwork in the office, interaction with local industry, awareness of current and predicted situations, and a genuine desire to improve the safety in the AOR. Focusing on prevention and applying risk-based approaches benefits everyone. For more information on these examples, contact the MSOs directly. For additional examples of how the Coast Guard has applied risk, check out the PTP web site at: ***http://www.uscg.mil/hq/g-m/nmc/ptp/cgfield.htm.***

Risk-Based Approach for Assessing and Mitigating Risk to Permanently Moored Passenger Vessels

By Rajiv Khandpur, Naval Architect, Program Manager, Passenger Vessel Safety, US Coast Guard

Background

Permanently moored vessels aren't always as permanent as they seem. There have been several instances when such vessels have broken free from their moorings, and this is an area for concern. In one case, a casino barge with almost 1000 passengers and crew on board broke loose during a severe thunderstorm. Fortunately, there was no vessel damage or passenger injuries reported. In another case, a casino barge with over 2000 passengers and crew was knocked loose from its moorings by runaway barges on a swollen river. Though no vessel damage was reported, approximately 30 passengers suffered minor injuries during the evacuation. In the December 1997 *M/V Brightfield* casualty in New Orleans, a deep draft vessel allided with a pier near four moored vessels, two of which were passenger vessels; sixty-six people were injured.

In each of these instances, the results could have been far worse. But they served a valuable purpose—they illustrated the need to review the mooring and siting arrangements for all vessels that carry passengers while moored. A Quality Action Team (QAT) was therefore chartered to review and evaluate the Coast Guard's involvement in the siting and mooring of passenger vessels that are permanently moored and to recommend measures for reducing the risk of casualty to those vessels.

QAT OBJECTIVES:

Obtain a snapshot of existing risk.

Review risk assessment techniques and determine appropriate measures to reduce the risk of allision for moored passenger vessels and other vessels that carry passengers while moored.

Recommend appropriate risk analysis tools and risk reducing strategies to support the framework for long-term policy guidance.

Explore the need to include this matter in a more comprehensive ports and waterways risk management study.

Analyze Coast Guard authority and the potential need for legislation/regulations to address this matter.

Data Analysis

In order to accurately identify all permanently moored vessels and their locations, the QAT tasked all Marine Safety field units to list each vessel (with its river mile location) that operated in their zone. The vessel also had to meet the following criteria: it has public access; it is permanently affixed to a dock as defined in the Marine Safety Manual Volume II, Chap. 10.I.1; it is floating; and it would carry a Certificate of Inspection (COI) if not permanently moored.

In addition to the location, the field units were also asked to assign risk scores for each vessel in six different categories. The scoring method and categories are explained in Table 1. A low score shows an undesirable situation (high risk) and a high score indicates a desirable condition (low risk).

Next, the QAT queried six years' worth of Marine Safety Information System (MSIS) data files (1992 to 1997) for any casualties (groundings, collisions, allisions, and breakaways) that occurred within one half a mile upstream of each location identified by the field units to have a permanently moored vessel. This process identified 295 distinct casualty events.

Finally, these 295 distinct casualty events identified through the MSIS data files were plotted against total risk score as assigned by the field units. This showed a positive correlation between the two. Thus it was evident that the field units' assessment of the risk at any given location was accurate and was borne out by historical data as provided by the casualty cases. Figures 1 and 2 illustrate the correlation between risk scores and casualty

Table 1: Permanently Moored Passenger Vessel Initial Risk Assessment. The risk model use uses six parameters to quantify the risk to the vessel. The parameters are designed to capture the key risk elements associated with permanently moored vessels. Each of the six parameters is scored on a scale of one to five. A low score indicates an undesirable condition and conversely, a high score indicates a desirable situation. Therefore, based on the six parameters, a vessel could receive a minimum total score of 6 and a maximum total score of 30. Rate the vessel on the six parameters as described in the "discussion column" using the following values as a rough guide:
1 – Poor; 2- Fair; 3 – Good; 4 – Excellent; 5 – Outstanding

CATEGORY	VALUE	DISCUSSION
Location		Value based on the vessel's site location in terms of the risk the vessel is exposed to from a collision or allision. For example, 1 = vessel sited on the outside bend of a river; 5 = boat in a moat. Other considerations/mitigating factors: If total score is 2 or less: Involve vessel owner /operator and review further risk mitigation actions. If score is still 2 or less, require owner to present a formal risk assessment.
Traffic		Value based on the amount/type/activities of vessel traffic adjacent to the PMV. Factors to consider—amount, size and frequency of traffic; speed of traffic/current; maneuvering constraints/limitations; vessel service. Other considerations/mitigating factors:
Response		Value based on the ability of local maritime response community (including federal, state, and local governments) to provide timely, adequate assistance to disabled/ damaged vessels. Other considerations/mitigating factors:
Anticipated environmental factors		Value based on the duration a vessel may be exposed to high risk due to anticipated environmental factors that occur annually, such as fog, river flood stage, storms, etc. For example, 1 = 4+ weeks/yr.; 5 = 0-1 week/yr. Other considerations/mitigating factors:
Severe and sudden environmental factors		Value based on how often vessel could be at risk due to unpredictable sudden and severe environmental factors such as hurricane, flash flood, tornado. For example, 1 = anticipated annual occurrence; 3 = occasional (every 5-10 yr.); 5 = unlikely (never occurred but possible). Other considerations/mitigating factors:
Passenger exposure		Value based on the amount of time and the number of passengers to which a vessel is accessible per week. For example, 1 = 100,000 passenger-hours/wk.; 5 = 2000 passenger-hours/wk. Other considerations/mitigating factors:
TOTAL		If total score is 13 or less: Involve vessel owner/operator and review risk mitigation actions. If score is still 13 or less, require owner to present a formal risk assessment.

cases. Further, it was evident that the majority of incidents occur at total scores of 13 or less. In fact, 64% of all casualty cases occurred on sites with a total risk value of 13 or less.

The QAT also looked at each of the risk factors (location, traffic, response, environment and passenger exposure) to determine if any one of them had a significant impact on its own. The individual risk factor that presented itself as the best predictor of risk was location. 41% of all casualty cases occurred on sites with a location risk value of 1 (being most undesirable), and 68% of all casualties occurred on locations with risk values of "1" and "2" combined (Figure 3).

This data analysis now provides two quantitative points with which to work. If the risk factor associated with location is set to a minimum of 3 the probability of a casualty can be reduced by 68%. Independently, by setting the overall risk score at a minimum of 14 the probability of a casualty can be

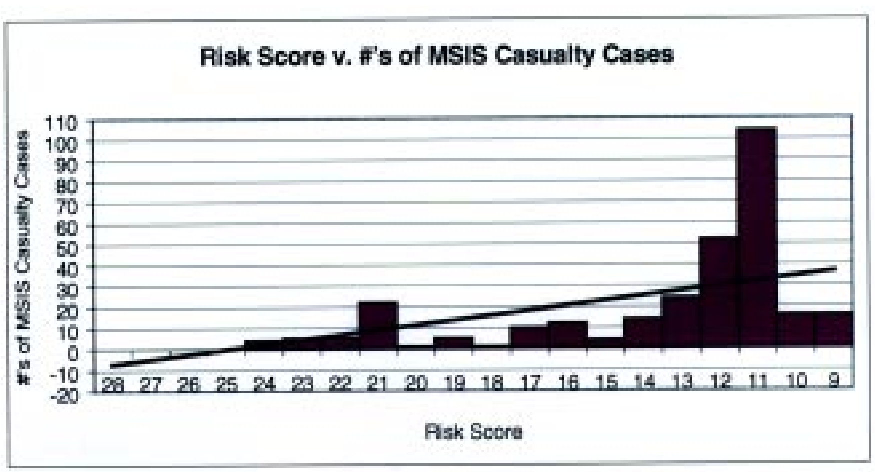


Figure 1.

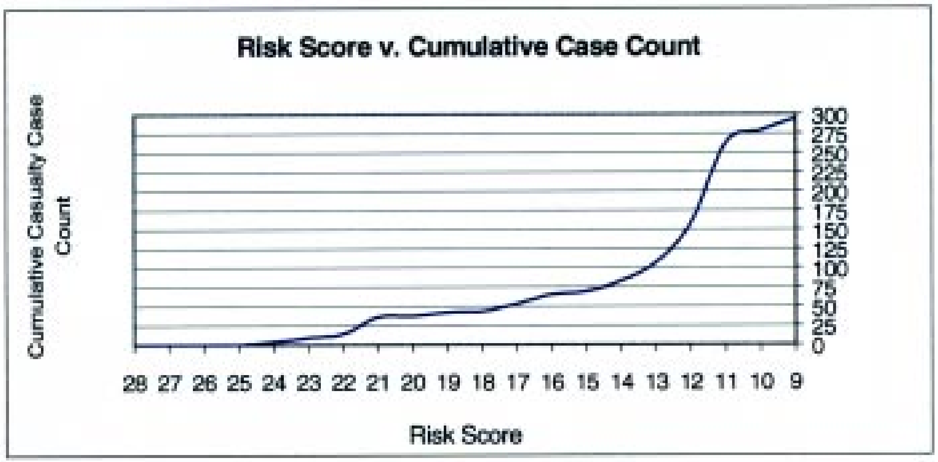


Figure 2.

reduced by 64%. By setting both a minimum value for location at 3 and total risk score of 14, the overall probability of a casualty can be reduced by 75%.

It is relevant and interesting to note that the risk scores assigned to the vessels by Coast Guard field units were made without the benefit of the MSIS casualty event data. When checked, though, the MSIS casualty event data fully supported and validated the risk model. This shows the value of experience, since it was on this experience that the field units based their scores.

Risk Mitigation

From the data analysis above, we see that appropriate site selection is the most effective way of managing risk to an acceptable limit. The first and best option is to alter the location to reduce or eliminate the risk of allision. However, in many cases site selection options are limited and other risk mitigation tools are needed to raise the location score to 3 or above. The next option could be to modify the site in a way that reduces allision, such as the installation of protective bumpers or "icebreaker" cells.

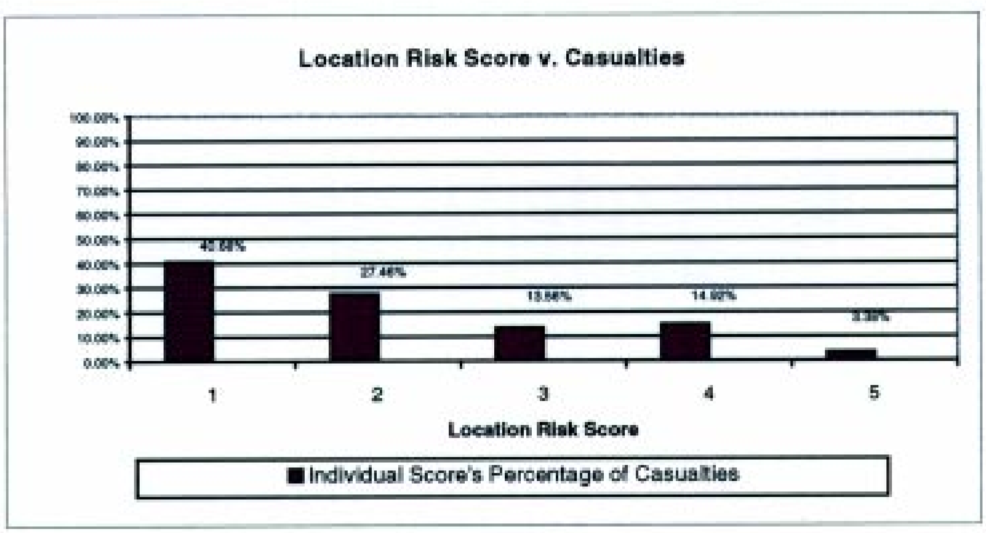


Figure 3.

Other options to reduce risk could be the use of operational controls such as the closure of businesses in high water, and requirements for emergency evacuation procedures and routine drills, radio watches, etc., or additional safety equipment requirements, such as ring buoys or personal flotation devices, etc. However, though such risk mitigation measures can cover a wide spectrum of actions, they must tailored to what works best for each individual situation.

Conclusion

In summary, this QAT showed that not only can risk-based approaches be an effective tool for managing safety, but that expert judgment can be a valid means of evaluating the risk. While many of these considerations were already being considered in siting decisions, the structured approach developed as part of this QAT will ensure that these decisions are objectively made and defensible.

Author's Note: The members of the QAT came from Coast Guard Headquarters unless otherwise indicated and were: CAPT James Garrett (Chair), CDR Robin Crusse, LCDR Rod Walker (MSO Louisville), LCDR Scott Kuhaneck (MSO Chicago), LCDR Tony Furst, LT Keith Janssen, Dr. Harry Hantzes, Mr. Rajiv Khandpur, Mr. David Houser, and Mr. David Edwards.

ORM In The U.S. Coast Guard...

Why?

We Can't Afford Not To!

By LCDR Dennis Becker, Assistant Division Chief, Afloat Safety Division, Coast Guard Headquarters

What began as an effort to enhance loss prevention in the U.S. Coast Guard has become an impetus to change its business focus from a compliance-based to a risk-based philosophy. Operational Risk Management (ORM) is a continuous, systematic process of identifying and controlling risks. ORM goes beyond loss prevention. It allows organizations to logically identify and capitalize on their capabilities to produce the greatest return on their investment of time, money, equipment, and personnel. To reinforce the Commandant's direction for "improved decision-making for superior performance" amidst a streamlined and downsized workforce, the Coast Guard simply can't afford not to implement ORM in order to minimize losses and therefore maintain mission readiness.

In response to recommendations by the National Transportation Safety Board in the early 1990s, the Coast Guard began to implement training programs designed to combat human error (which continues to be the major cause of mishaps) by focusing on team performance to prevent mishaps. Through the years, these programs became formalized as Team Coordination Training (TCT) and Crew Resource Management (CRM), which are the key delivery mechanisms for teaching risk management concepts throughout the Coast Guard. Having advocated these concepts for many years, TCT and CRM have encouraged a "bottom to top" approach toward service-wide acceptance of risk management principles. The results of a multi-mission risk management workshop held in 1996 became the framework for a standardized risk management process, which is supplemented with standard terminology, required competencies, implementation plans with an Integration Job Aid, and program responsibilities. Staff from the Afloat Safety Division at Coast Guard Headquarters tailored the results of risk management program research from other services and private industry to craft a risk management policy that is unique to the multi-mission nature of the Coast Guard. The end result of this process is a Commandant's Instruction on ORM.

While developing this directive, Afloat Safety staff carefully considered the issue of implementation. Recognizing that differences in mission complexity and timeliness of required decisions exist, implementation is discussed in a context corresponding to different levels of ORM application. The Integration Job Aid includes an integration process model and other guidance to lead units through their implementation efforts, from detailed processes, to more time-critical activities.

The benefits of the TCT program in reducing cutter and small boat mishap rates related to navigation and mobility of the asset can be seen in Figure 1. Total Class A-C vessel and small boat mishaps have dropped from 234 in FY94 to 84 in FY98. The effect of the CRM program in reducing aviation mishap rates can be seen Figure 2. ORM's additional benefits include safeguarding our members' health and welfare and conserving vital resources and equipment. Shifting to a risk-based philosophy of conducting business helps the Coast Guard achieve the Commandant's direction to "perform all operations flawlessly."

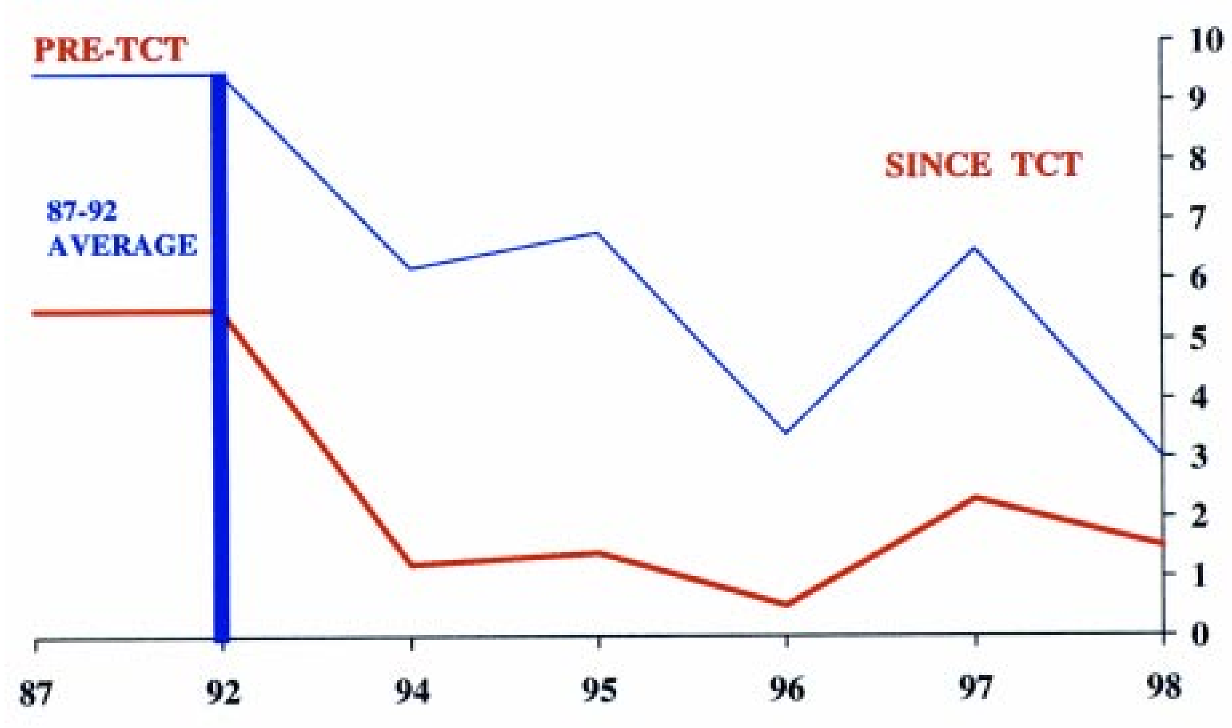
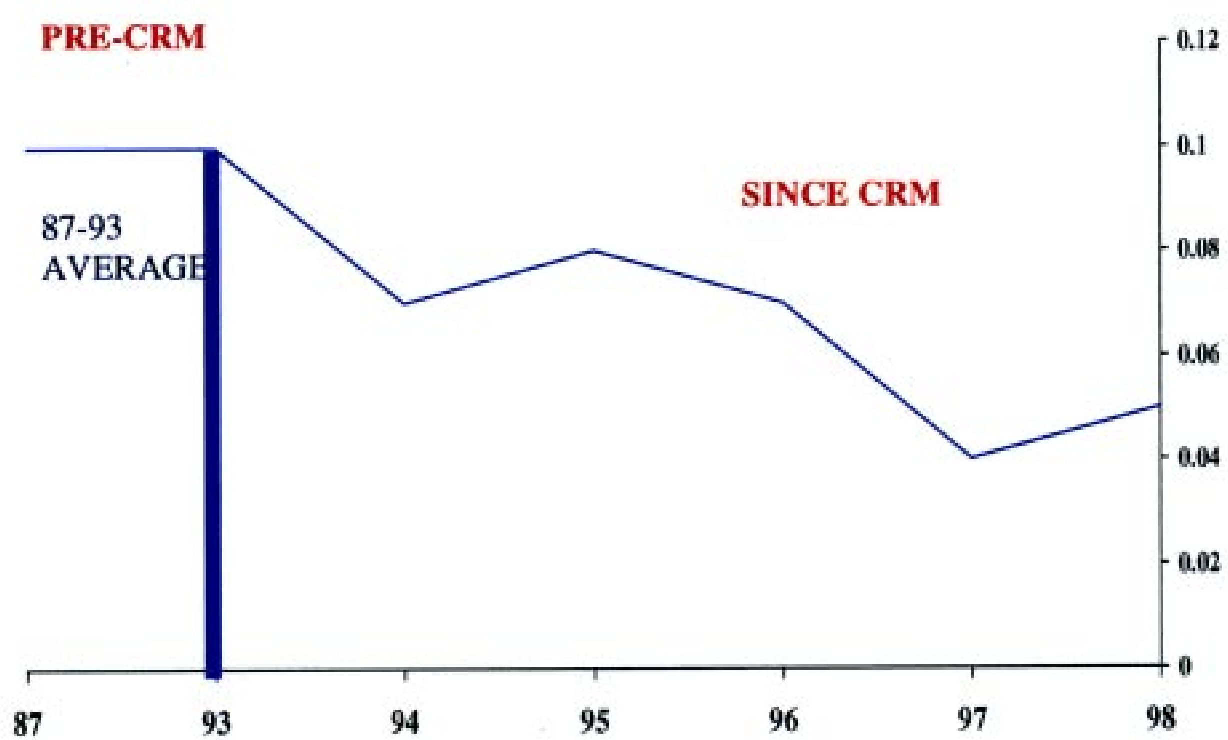


Figure 1: Cutter And Small Boat Mishap Rates (Class A-C)
Rate/100,000 Operating Hours

Quite simply, now is the time to put into practice what the Coast Guard has been reinforcing for many years through TCT and CRM. Implementing ORM is the commitment necessary to take that step. As if the goals of reducing loss of life and property were not enough, the Coast Guard can no longer afford major losses of any kind as a streamlined organization that is doing as much, and in many cases more, with fewer resources.

Figure 2: FLIGHT MISHAP RATES (CLASS A-C, ALL AIRCRAFT)
Mishap Rate per 100 Flight Hours



Alternate Watchstanding

By William Abernathy, Human Factors Engineer, Human Element and Ship Design Division
and
Cal Bancroft, Vice President, Operations, Ocean Shipholdings

It's interesting to trace back ideas. Frequently, the smallest pieces of information add up to great realizations. This is especially true with risk-based approaches, where the study of an apparent cause can lead to the recognition of another deeper cause, and so forth down the line, ultimately arriving at the root cause. Such was the discovery by the Chemical Transportation Advisory Committee (CTAC) with the alternate watchstanding system.

At the fall 1998 working session of CTAC, members heard a presentation by the Prevention Through People (PTP) Subcommittee chair on an alternate watchstanding system, which had been presented for informational purposes to the delegates at an International Maritime Organization (IMO) meeting earlier in 1998. The PTP subcommittee of CTAC had been wrestling with its long-term task to examine manpower resources to meet performance standards, staffing levels, watch length, and effects of circadian rhythms on personnel. Using a logical, risk-based approach, CTAC looked at the various issues associated with manning (including performance standards, staffing levels, and safety) and identified fatigue and the factors contributing to it as a significant concern. Continuing with this approach, CTAC delved deeper into the various causes of fatigue and identified numerous direct and associated issues, such as conflicts with circadian rhythm and short sleep and rest cycles without maximal restorative value. When the alternate watchstanding system program was reviewed and discussed, CTAC knew they had found their tasking on manpower resources with this potential means of reducing the risk associated with fatigue.

Mariners' fatigue is of great concern to the Coast Guard and other bodies in the marine industry. Although there are several studies underway by the Coast Guard and other parties to examine fatigue and sleep loss issues on board vessels, very few studies or experiments have actually been completed. One study, funded by the West German Ministry for Technology and Research, confirmed that the traditional three-watch system of four hours on watch and eight hours not on watch may produce sleep deprivation. Sleep deprivation may diminish vigilance, as well as judgement and performance in monitoring. The same study proposed a new system that would give ships' officers fourteen hours of time off-watch to be used as needed. This lengthy time period allows for full-length periods of unbroken sleep each day.

The CTAC PTP subcommittee confirmed that alternative watchstanding arrangements were permissible under United States Statute 46 U.S.C.8104, but that the establishment of adequate watches remains the responsibility of the vessel master.

Cal Bancroft, CTAC PTP subcommittee chair and Vice President Fleet Operations for Ocean Shipholdings, Inc., distributed the proposed alternate watchstanding system to the deepsea fleet that his company operates and manages. "I believe in giving as much information, such as this alternative watchstanding system, out to the ships," said Bancroft. "It is in keeping with our Safety Management System which we collectively created in compliance with the ISM Code. Besides, our masters and chief engineers often respond with improvement in the operation of our ships. We are honoring our mariners."

Alternate Watch Operating Schedule.

	HOURS ON WATCH											
OFFICER	2	4	6	8	10	12	14	16	18	20	22	24
SECOND MATE	00-06				08-10							
CHIEF MATE				06-08			12-18					
THIRD MATE						10-12				18-24		

All of the masters voluntarily implemented the alternative schedule on a trial basis from late October 1998 to March 1999, and continue its usage. Following the initial test period, the participating officers provided written comments to Bancroft, who then passed them on to CTAC and the Coast Guard. Captain Duane M. Hockenberry, Master of the *M/V Paul Buck*, was the first master to implement the schedule. "At first glance I thought this [the schedule] was the strangest thing I had ever seen. The more I looked at the proposed schedule and the longer I thought about the implications of it, the more unique the proposed schedule became. I made copies of the schedule and passed to all of my watchstanding mates . . . To my surprise each mate came back to me with very positive feedback and all requested or agreed we would try the new schedule."

Captain Jordan M. Katz, one of the masters of the *M/V Gus W. Darnell*, readily agreed. "I saw improved efficiency, alertness, and personnel performance as a result of the prolonged rest periods. My officers were better able to take care of routine duties such as inspections, drills, and maintaining safety and lifesaving equipment. As ample time is now available to accomplish these tasks, the mates are less likely to overlook items that might lead to a chain of errors at a later date."

Captain Severin A. Samuelson, the other permanent Master onboard the *M/V Paul Buck*, stated, "My mates were more rested. I knew that they were better prepared to work during intense periods, such as running coastwise, since they had long rest periods prior to the work and would have opportunity to recover once departing from the coast operation."

Captain Samuelson did note that some of the "old timers" resisted the change initially. "When in port, my second mate was able to go ashore, do some shopping, and take in a movie and still return to the ship in time to get a full eight hours of rest prior to going on watch. Previously, OPA 90 regulations would preclude such liberty opportunities. I knew I had a convert then."

All of the Captains commented favorably that the officers were able to interact with all of the unlicensed watchstanders with an enhanced perspective. This gave the officers the opportunity to better know the capabilities of their unlicensed crew when assigning tasks. This had a direct result of fewer errors being committed by the unlicensed complement.

Another master reported, "Fatigue, a factor prevalent on three-mate tankers, is greatly reduced. All mates are now afforded the opportunity for a prolonged rest period to recuperate after reaching OPA/STCW [Oil Pollution Act/Standards for Training, Certification and Watchkeeping] maximum work hours. As lack of rest is one of the major reasons errors occur, the minimizing of this is definitely another primary benefit of the new schedule. Even when the vessel arrives in port at a late hour, or calls on several ports within a short time frame, there is always an adequate unbroken sleep period."

The crew of the *M/V Richard G. Matthiesen* conduct an emergency tank rescue drill at sea.

Perhaps the best endorsement of the alternative schedule was from Captain Hockenberry:

> "Without question, I can report that the new schedule has been a complete success. I would say it is the best change we have ever implemented here and it is by far the best new idea I have seen in the past twenty years."

At the spring 1999 CTAC meeting, Bancroft recommended that the full committee of CTAC present the findings of his masters and officers to the Ship Operators Cooperative Program (SOCP) as a PTP effort, a good safety measure, and a demonstration of benefit of the organizational safety management systems to the transportation industry. This was accomplished at the March SOCP meeting. SOCP noted to its members that the non-traditional schedule did not violate any U.S. law or regulation or union rules.

Other companies have also conducted trial implementation of the alternate watch schedule. The Coast Guard will continue to follow the experience of the crews who use this system with great interest. The Coast Guard feels that this is an effective way to counter the mariners' most constant companion—fatigue. If you would like more information, contact the PTP coordination staff by e-mail at fldr-he@comdt.uscg.mil or call (202) 267-2997. The information has also been posted on the PTP Web site at http://www.uscg.mil/hq/g-m/nmc/ptp/industry.htm.

Risk Assessment Methodologies Applicable to Marine Systems

By Dr. B. John Garrick, NAE, Chairman, PLG, Incl., Newport Beach, California

A review has been made of risk assess ment methods and practices suitable for application to marine systems, with a report going to Coast Guard Headquarters[1]. This project was initiated to support the Coast Guard in its planning stages for the development of a basic risk-based approach to marine safety and environmental protection regulatory issues. While this risk-based approach is comprised of the three primary elements shown in Figure 1, this project focused solely on the approaches and methodologies for risk assessment in the maritime industry. The specific thrust of the review was the role of quantitative methods in marine system risk assessments, although qualitative approaches were considered as well. The marine systems of primary interest were offshore production and marine transportation systems.

In order to develop recommendations for the maritime industry, a review was made of the risk-based approach experiences of other government agencies and industry sectors, including chemical, petroleum, nuclear power, space, and defense. These comparisons provided a benchmark of progress in the marine field.

The use of quantitative risk assessment has its origins in the nuclear power industry, most notably with the release of the reactor safety study[2] in 1975. This study represented a significant advance in the use of risk assessment to ensure safety. Much work has followed this study, and the nuclear industry has developed a robust resource of methods, data, and expertise for the use of risk assessment to address safety and environmental protection issues in complex technological systems. With this expertise, and the demonstrated value of using these approaches, the nuclear regulatory process has increased its reliance on risk assessment to ensure safety.

The space and defense industries have also been very active in the risk assessment arena, and have been the cradle for many of the basic techniques employed in risk assessment, including fault tree analysis, reliability analysis, and failure mode and effect analysis. However, these industries, while clearly recognizing and pursuing the benefits of a risk-based approach, have been somewhat more cautious in their approach.

There are several basic aspects of the marine field that make it unique as it begins to develop the use of risk assessment methodologies.

The chemical process and petroleum industries have also been very active in the use of risk-based approaches, albeit in a very different way. Among the important differences is the large experience base that exists in the chemical field. Besides the effect of new regulations, the Center for Chemical Process Safety has been a force and a valuable resource for the chemical industry's move toward the use of risk assessment methods. Applications of qualitative assessments in the chemical process industries include not only safety and environmental protection, but also cost and schedule management. In fact, the latter, due to the extremely competitive nature of the industry, has proven to be a significant driver in the

1 Garrick, B. John, "Risk Assessment Methodologies Applicable to Marine Systems," prepared for the United States Coast Guard, April 1999.

2 U.S. Nuclear Regulatory Commission, "Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," WASH-1400 (NUREG-75/014), October 1975.

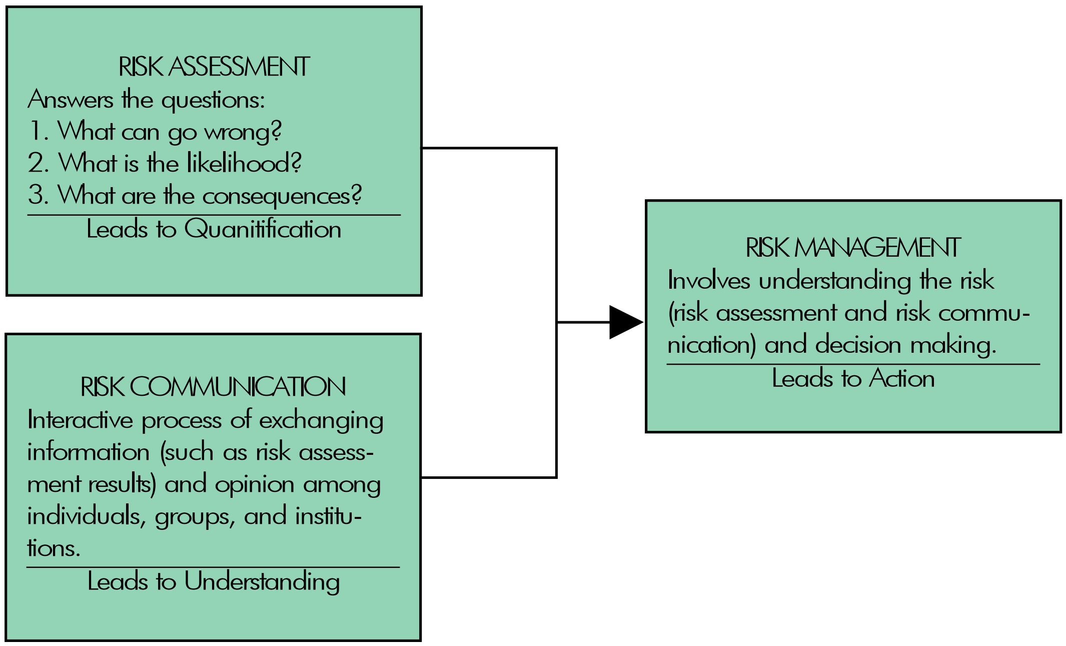


Figure 1.

use of risk assessment for this sector of commerce.

In contrast, the maritime industry has not been as active in the use of risk-based approaches, although there are indications of increasing interest and use. Examples of maritime applications include the International Maritime Organization's Formal Safety Assessment process, the U.S. Coast Guard's Risk-Based Decision-Making Guidelines, the Mineral Management Service's Safety and Environmental Management Program, and the Prince William Sound and Puget Sound risk assessments. While none of these activities adopt the complete scope of quantitative methods, they clearly indicate an embracing of the risk-thought process.

There are several basic aspects of the marine field that make it unique as it begins to develop the use of risk assessment methodologies. Specifically, marine systems are confined, isolated systems; self-reliant (rely on self-produced electricity, water, etc.); have limited manpower and material resources; and have limited emergency response capabilities. In general, the marine field systems may be classified as either movable systems (for example, ships) or fixed systems (for example, offshore platforms). These basic characteristics (in particular the movement of the ship as system through a changing geographic and environmental picture) demand particular attention and an approach focused on the dynamics involved.

In addition to these basic methodological issues, this study also looked at some very basic data issues, primarily due to repeated concerns expressed regarding the inability to pursue maritime risk assessments due to the lack of adequate data. Of particular concern is the lack of data on common cause failures and interdependencies between systems, as well as human response data and basic exposure data such as the number of vessel operating hours and shipboard crews. However, experience indicates that the best way to get a handle on the data issue as it relates to risk assessment is to simply do a few such studies and use the results to guide the most efficient approach to data collection and processing. Furthermore, it is believed that much more data exist than are used. One important recommendation made in the report to the Coast Guard was for the marine industry to establish stronger ties with other agencies active in the use of risk assessment methods. In this manner, access can be obtained to numerous data sources for equipment, structures and opera-

Understanding from a risk perspective how the system actually works is, in itself, important in being able to envision what can go wrong with the system.

One overarching result of this review is the recommendation to develop stronger ties with other agencies and industries more advanced in the use of the risk sciences.

tions that are similar to their maritime counterparts (for example, electrical and mechanical equipment failure rates).

It is important to note that the absence of systems performance data is not a valid reason for failing to do a risk assessment of a complex system. On the contrary, it can even be argued that the less data there is on a system, the more important it is to do a risk assessment. In the case of essentially an infinite amount of data, a risk assessment is unnecessary as the experience base indicates exactly what the risk is. That is, the need for a risk assessment is inversely proportional to the experience base. The reason a risk assessment, in the absence of high quality data, is valuable is because most of the effort is in modeling the logic of the system, something that does not require performance data and is critically important in understanding how the system works. Understanding from a risk perspective how the system actually works is, in itself, important in being able to envision what can go wrong with the system. This is perhaps the most important part of a risk assessment.

One overarching result of this review is the recommendation to develop stronger ties with other agencies and industries more advanced in the use of the risk sciences. Active agencies in this area are the U.S. Nuclear Regulatory Commission and the U.S. Environmental Protection Agency. Active industries include nuclear, chemical, space and defense. Other recommendations include:

1) The development and commitment to a general plan of direction of the marine industry in the more efficient use of in-depth risk management tools;

2) The adoption of a general risk assessment framework to baseline marine risk assessment activities;

3) Expansion of the risk measures beyond oil spills and accidents to include human health effects and environmental impacts; and

4) Expansion of the risk assessments to consider such phenomena as common cause failures, uncertainty analysis, human factors, and organizational impacts.

In summary, enhancements can be made to the current practices of risk assessment in the marine field in a number of areas. They include methodology, the adoption of an integrated risk-based decision-making strategy, and specific analytical techniques. It is recommended that a plan for risk management be developed for a major component of the marine field. The plan should address the above issues through the integration of the various elements of risk-based decision-making and especially address the issue of the evolution of activities, including qualitative methods, to an increasingly quantitative approach to risk assessment and risk management. By doing so, the marine industry can reap the rewards already enjoyed by the nuclear, chemical process, and other industries noted, with a significant return on investment.

Mariner's Seabag

NMC TAKING THE TIME TO RECOGNIZE WORLD WAR II MARINERS

LTJG Scott Beighau, Project Officer, WWII Merchant Mariner Veteran Affairs, National Maritime Center

We don't see many of them around any more—this particular subset of the "Great est Generation." They rest quietly in retirement communities or, sadly, in the very ground whose freedom their heroics helped secure. They are the merchant mariners of World War II. Like the armed forces they transported and supplied, these men left their homes and met the challenge of facing the enemy. They did it with only the barest of training for war, and usually, with the barest of defensive armament also. It is estimated that about 200,000 mariners served during the war. They left behind the same families, and widows, as other servicemen. More than 5600 did not return. Over 600 suffered the ravages of enemy prison camps.

Their contributions and sacrifice did not go unnoticed by the military leaders of the day. General Douglas MacArthur said:

> "At our side they have suffered in bloodshed and death. The high caliber of efficiency and courage they displayed in . . . the invasion of the Phillipines marked their conduct throughout the entire campaign in the Southwest Pacific. . . I hold no branch in higher esteem than the merchant marine service."

And scarcely 5 months into the war President Roosevelt placed the merchant marine squarely among the vital tools of war when he said:

> "Two million men have been called to the colors. In far places and near, our soldiers, our sailors, our air pilots, the beleaguered men of the Merchant Marine have shown the stuff of heroes."

Following the war, the merchant marine returned to its civilian role moving the raw materials of commerce. As time passed and the nation settled into relative peace, efforts to acknowledge the contributions of merchant mariners and other groups that supported the war effort were engaged. It took until 1977 for a process to be enacted that would establish a structured mechanism for providing that acknowledgement. The GI Bill Improvement Act of 1977 (Public Law 95-202) directed the Secretary of Defense to prescribe regulations for reviewing the service of various wartime groups to determine whether their service should qualify for veterans' benefits.

Those regulations are now found in Part 47 of Title 32 of the Code of Federal Regulations. The regulations establish the Civilian/Military Service Review Board (C/MSRB), which is charged with reviewing the applications from groups seeking veterans' status.

After a long and somewhat tortuous history, the C/MSRB, in 1988, approved veterans' status for merchant mariners who served on ocean-going voyages between Pearl Harbor Day and VJ Day (December 7, 1941 to August 15, 1945). After so long a wait, the result was immediate and substantial. Nearly 50,000 mariners came forward in the first year to have their service qualified.

As keeper of merchant mariner records, the Coast Guard undertook the tedious task of obtaining records from the Federal Records Center and reviewing the sea service contained in them. Like their Armed Forces counterparts, qualifying mariners were issued a DD Form 214 (Certificate of Release of Discharge from Active Duty) and a DD256CG (Honorable Discharge Certificate).

Mariner's Seabag

A three-shift task force of nearly 200 employees was mounted to meet the demand. As the initial rush was quelled, the task force was reduced consistent with the demand, until today, two employees at the Coast Guard's National Maritime Center (NMC) keep up with about 1000 applications that still arrive each year. To date, the Coast Guard has reviewed the records of over 80,000 WWII mariners and issued qualifying documentation to those with the required service.

Although merchant mariners were finally recognized in 1988 for their service in World War II, the qualification period was shortened compared to that applicable to other veteran groups. This was despite the very real dangers they continued to experience after the hostilities had ended. Several U.S. flag vessels were lost or damaged as a result of striking enemy mines. Merchant mariner organizations, such as the U.S. Maritime Service Veterans Organization, continued to fight for an additional 10 years to extend the recognition period for veteran status through the end of 1946, the official date recognized by President Truman as the end of World War II.

Finally, on November 11, 1998, President Clinton signed Public Law 105-368; the Veterans Programs Enhancement Act. That law extended the qualification period to December 31, 1946, although it limited benefits for mariners qualifying in this "extended period" to burial and interment benefits only. The law also required that the Coast Guard collect a $30 fee to process each application that qualified under this extended period.

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On April 23, 1999, the Coast Guard received authority from the Department of Defense to issue form DD214 (Certificate of Release or Discharge from Active Duty) and form DD256 (Certificate of Discharge) for certifying qualified service under the new law. The NMC was tasked with the responsibility of issuing these certificates.

Knowing the urgency with which mariners had anticipated this recognition, the NMC realigned staff and initiated new procedures, including an informative Web page (**www.uscg.mil/hq/g-m/nmc/wwiimm.htm**), to help expedite the certification process. Since November, over 2000 mariners have submitted applications for certification under the new law. The NMC continues to process these applications in the order received.

To qualify under Public Law 105-368, a member must submit an application (form DD2168) and $30 check or money order, payable to the U.S. Treasury, to:

WWII Merchant Mariner Qualification
Highland Community Bank
P.O. Box 804118
Chicago, IL 60601-4118

The NMC uses this U.S. Treasury-contracted bank to handle the accounting associated with collecting the processing fee required under the new law.

The application forms (DD2168) are available from Veterans Administration Offices, merchant marine veteran organizations, and from the National Maritime Center. For more information, log onto the NMC's WWII merchant mariner web page at **www.uscg.mil/hq/g-m/nmc/wwiimm.htm**.

Nautical Queries

Deck Questions

1. Which statement about entry into a water ballast tank that has been sealed for a long time is TRUE?

A. A "buddy system" should be used where someone enters the tank with you.
B. Sea water acts on the ship's metal and generates chlorine which may accumulate in poisonous quantities.
C. You should always wear a gas mask.
D. After ventilation and testing, and the tank is found safe for entry, someone should stand by at the tank entrance while you are inside.

2. What would be an example of a B-I extinguisher? (small passenger vessel regulations)

A. 2.5 gallon foam
B. 10 pound carbon dioxide
C. 2 pound dry chemical
D. 5 pound foam

3. On small passenger vessels, which device(s) must be fitted to a fuel line's tank connection?

A. A fuel strainer
B. A shut-off valve
C. A tubular glass gauge to indicate the fuel level
D. All of the above

4. After making the required notification that a large oil spill into the water has occurred, the FIRST action should be to _____________.

A. apply straw or sawdust on the oil
B. contain the spread of the oil
C. throw grains of sand into the oil
D. have the vessel move out of the spill area

5. To determine the pressure and temperature limitations under which LFG is required to be transported on a barge, you should look at the ________.

A. Certificate of Inspection
B. loading order
C. rules and regulations for tank vessels
D. tankerman's document

6. The compass rose on a nautical chart indicates both variation and _____________.

A. deviation
B. annual rate of variation change
C. precession
D. compass error

7. When weight-testing a davit launched life raft on a mobile offshore drilling unit, the deadweight equivalent for each person in the allowed capacity of the raft is ___________.

A. 155 pounds
B. 165 pounds
C. 175 pounds
D. 185 pounds

8. What is the purpose of a striker plate?

A. Provides surface for applying force on machinery
B. Provides landing surface for the sounding bob
C. Absorbs machinery vibration
D. Prevents valve stem over-travel

9. On November 1st the zone time is 1700 EST (ZD +5) in LONG 75ø W. What is the corresponding zone time and date in LONG 135ø E?

A. 0700, November 2nd
B. 0700, November 1st
C. 2200, November 1st
D. 2200, October 31st

10. Your ship is navigating independently in heavy ice when it becomes beset. Which statement is FALSE?

A. The vessel will most likely require an icebreaker to free her.
B. The vessel may be able to free herself by pumping ballast from side to side.
C. The propeller is more susceptible to ice damage when turning slowly than when stopped.
D. It is advisable to clear the rudder area of ice by using ahead turns before backing down.

ANSWERS: 1-D, 2-C, 3-B, 4-B, 5-A, 6-B, 7-B, 8-B, 9-A, 10-C

Nautical Queries

Engineering Questions

1. One of the most common causes of reduction gear failure is gear wear caused by scoring as a result of _____________.

A. surface fatigue of the glass
B. an inadequate lube oil film
C. plastic flow of the gears
D. fretting corrosion from water contamination

2. A poorly cleaned lube oil purifier bowl may result in _____________.

A. insufficient oil supply to the gravity tank
B. improper separation
C. excessive lube oil consumption
D. excessive water discharge rate

3. The ring lands on a large, low-speed, main propulsion diesel engine piston may crack due to ___________.

A. insufficient cylinder liner wear
B. contaminated lubricating oil
C. high main lube oil system temperature
D. insufficient ring groove clearance

4. Clogged gas passages in a boiler may result in _____________.

A. slag accumulations on refractory
B. overheated superheated support plates
C. warped water wall headers
D. rapid fouling of sprayer plates

5. When timing gear backlash for a Roots-type blower has become excessive, the problem is properly repaired by ____________.

A. renewing the drive gear
B. renewing the driven gear
C. renewing both driving and driven gears as a set
D. shimming and pinning the gears with proper backlash

6. A mechanical and/or hydraulic action preventing the over-correction of the fuel supply, while producing transient speed droop is called ____________.

A. stability
B. hunting
C. compensation
D. sensitivity

7. The cooling water supplied to the vent condenser in a DC heater is ___________.

A. seawater
B. fresh water
C. potable water
D. condensate

8. When a main propulsion turbine throttle malfunction develops, affecting both the main and secondary control stations, you should ____________.

A. override the automated circuit and manually control the engine
B. override the automated circuit and shut down the engine
C. allow the automatic shutdown circuit to shut down the engine, then locate the problem
D. immediately make an entry in the engine log

9. Prior to starting, the purpose of turning over a main propulsion diesel engine with the test cocks open is to ____________.

A. test the starting system
B. remove condensation from the cylinders
C. check the compression
D. check for proper lube oil pressure

10. A diesel engine cylinder head can crack as a result of ____________.

A. a leaking seal ring
B. heat transfer from exhaust valves
C. restricted cooling passages
D. overheated intake valves

ANSWERS: 1-B, 2-B, 3-D, 4-A, 5-C, 6-C, 7-D, 8-A, 9-B, 10-C