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Waterways Management

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WATERWAYS MANAGEMENT

FEATURE ARTICLES

On the cover: The recent proliferation of cruise ships has only added to the vessel traffic in U.S. ports, placing the management of waterways in the spotlight more than ever. Maritime Administration photo.

DEPARTMENTS

Next issue: STCW/ Annual Index

Assistant Commandant's Perspective

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

Preparing our Waterways for the 21st Century

There has never been a more exciting time to be a "waterways manager!" Since I began my assignment as the Assistant Commandant for Marine Safety & Environmental Protection, I have worked closely with MARAD and other agency partners to raise the visibility and garner the necessary support to resolve some longstanding waterway issues.

In November 1997, Admiral Kramek, the Coast Guard Commandant at the time, briefed Secretary of Transportation Rodney Slater on waterways management and the need for the Department of Transportation to be more involved in light of trends and projections that waterborne trade would double, or even triple, over the next 20 years. The Secretary agreed and has been a champion ever since. This briefing on waterways management transitioned into the DOT *Marine Transportation System (MTS) Initiative.* This has been a great interagency and stakeholder partnership, and the most collaborative marine transportation effort that it has been my privilege to be a part of in my 33 years of Coast Guard service. A principle objective in briefing Secretary Slater was to put waterways management on the "national agenda," to make it an issue of importance to high-level government and industry executives. I would say we accomplished that objective, but that is only the beginning. There is still much work to be done to attain the full MTS vision, described on page 9.

"Waterways management" is not new to the Coast Guard. What is new is a better understanding—both inside and outside the service—of the strategic importance of the MTS and the value of Coast Guard waterways management efforts in advancing our national interests. This issue of *Proceedings* includes an historic overview of Coast Guard waterways management as well as a look to the future for the waterways management business line. Several other articles provide a snapshot of what is happening in the vessel traffic management arena; an overview of waterways management research and development; and a sampling of specific waterways management initiatives, including how several of our field offices and NOAA are working to ensure the safety of our waterways. These articles represent just a few of the many waterways management issues that the Coast Guard is involved in to ensure that our waterways do not become the weak link in our national transportation system.

As you read this issue of *Proceedings*, keep the MTS vision in mind.

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By the Way... Editor's Point of View

By Edward Hardin

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

Challenges of Waterways Management

The first Congress authorized the construction of lighthouses and other aids to navigation in our coastal waters back in 1789. Little did they know that this was the beginning of waterways management in the United States. Our country's navigable waterway system is massive, over 25,500 miles long and containing about 300 deep-draft and 600 shallow-draft ports and harbors. More than 200 years after the authorization to construct lighthouses, managing America's waterways effectively and efficiently remains a challenge.

As you read this issue of *Proceedings* dedicated to Waterways Management, you will come to realize that there are many parts of this puzzle and that it is necessary to have the backing of all the major stakeholders. There has never been a greater public demand for our limited natural resources. On page 15, LT Calhoun mentions a 200-300% increase in tonnage trade over the next twenty years, a 65% increase in recreational users, increases in commercial fishing, and a staggering 6.5 million cruise ship passengers by 2002. Many waterway recreational activities are competing with each other for space as well as with non-recreational functions. These increases in use can sometimes lead to serious problems, such as user conflicts or accidents and fatalities. You can see why there has to be one integrated plan to manage the social, cultural, and economic aspects of our waterways.

As Mr. High states in his article on page 5, "the team wins only when everyone gets to the top of the mountain. Until that happens, no one has succeeded." With the right action, our vision for healthy waterways is achievable. But we all have things to do! And that means we want you to get involved.

Meet the Director

Jeffrey P. High, Director of Waterways Management, U. S. Coast Guard

Jeffrey High was promoted to the Senior Executive Service and began his current position as the Director of Waterways Management on June 14, 1998. His specific responsibilities include USCG waterways management plans and policy, port security, vessel traffic management, and Great Lakes pilotage. In this position, he is a U.S. delegate to the International Maritime Organization's Navigation Subcommittee, a member of the National Port Readiness Network Steering Committee, and co-chair of the Interagency Working Group on the Marine Transportation System.

Mr. High attended the USCG Officer Candidate School and was commissioned as an Ensign in January 1971. After three years as a junior officer, assigned to the Civil Engineering Division at Coast Guard Headquarters, he became a civilian employee of the Coast Guard. Since then he has advanced through a wide variety of jobs at Headquarters, including positions in Civil Engineering, planning, acquisition, programming, budgeting, information management, logistics, and organizational analysis. His assignments included Senior Reviewer with the Programs Division, Assistant Chief of the Logistics Management Division, and Chief of the Management Effectiveness Staff in the Office of the Chief of Staff. From 1996 to 1998, he held the Department of Transportation Chair as an instructor at the Industrial College of the Armed Forces.

Mr. High holds an undergraduate degree in Civil Engineering from the University of Michigan (1970), a masters degree in Systems Management from the University of Southern California (1974), and a Master of Business Administration from George Mason University (1982). He is also a graduate of the Industrial College of the Armed Forces (1991), the Federal Executive Institute (1994) and the DOT Senior Executive Service Candidate Development Program (1995), which included a four-month assignment as the Special Assistant for Research and Technology in the Office of the Secretary of Transportation.

Mr. High's professional honors include: the Secretary's Award for Meritorious Service (DOT Silver Medal), Commandant's Superior Achievement Award (DOT Bronze Medal—two awards), Coast Guard "Unusually Outstanding" merit award, and Department of the Army Commander's Award for Public Service, plus several other individual and team awards.

Mr. High was born in Waterloo, Iowa on November 29, 1948. He currently resides in Oak Hill, Virginia, with his wife, the former Kathy Musso of New Orleans, Louisiana. Jeff and Kathy have four children: Rob, Jimmy, Kristina, and Katie.

Waterways Management Leadership for the 21st Century

By Jeffrey P. High, Director of Waterways Management, USCG Headquarters, Washington, DC

Introduction

One of the Commandant's top five goals—in fact, one of his "Imperatives"—is "Leading a Waterways Management Initiative for the Department of Transportation." As the U.S. Coast Guard's Director of Waterways Management, I am ultimately responsible and accountable for getting this done. Fortunately for me, a relatively "new kid on the block," I've gotten lots of help. I have an enthusiastic and energetic staff, a very supportive boss, and an environment that is ripe with opportunities. When I arrived on the job, I also inherited a Waterways Management Executive Steering Committee (WWM ESC) that had put together an excellent game plan to get the ball rolling. Over the past 18 months, we have built on that plan and can claim some significant achievements.

These are my thoughts on the waterways management leadership challenge and where I believe it will take us. I'll also define what waterways management means to me. Then, I'll describe the nation's Marine Transportation System (MTS)—one of the Secretary's "Flagship Initiatives." Next I'll discuss the strategic importance of our MTS and the strategic environment which affects waterways management and the MTS. With that backdrop, I'll then draw upon what I have learned about strategic leadership to discuss the kind of leadership that is required for waterways management in the 21st century. Finally, I'll discuss where we are and where we are going with waterways management in the Coast Guard and cap that with a final thought on leadership.

What is waterways management?

The Coast Guard claims its roots back to 1790, with the formation of the revenue Cutter Service. If you want to get technical, waterways management goes back even further than that. The Lighthouse Service, which later became part of the Coast Guard, was actually formed in 1789. This Service, which was the nucleus of the Coast Guard Aids to Navigation program, has clearly contributed to waterways management for more than 200 years. So, we've been in this business line for a long time. However, the question remains—besides being a basic role of the Coast Guard, what is waterways management?

In a recent briefing to the Interagency Task Force studying the roles and missions of the U. S. Coast Guard, waterways management was defined to include all those functions which facilitate and manage the flow of marine transportation. Examples of these functions include: marking channels; breaking ice; providing vessel traffic information; anchorage oversight; directing vessels during accidents, natural disasters, special events, etc.; and other traditional functions performed by Captains of the Port (COTP), including port security. Traditional Coast Guard waterways management mission areas are then: aids to navigation, domestic icebreaking, bridge administration, vessel traffic management, port security, and other COTP functions. All of these functions fall under the Coast Guard's and the Department of Transportation's strategic goal on mobility.

The Marine Transportation System

If the goal is mobility and the functions listed above are the elements of waterways management, then what is the context in which Waterways Management applies? In my view, the bigger picture is the Marine Transportation System (MTS). To understand the strategic environment of waterways management, we first need to understand the MTS.

The MTS is a subsystem of the nation's overall transportation system. It includes waterways, ports, and their intermodal connections (plus vessels and vehicles, and MTS users). The MTS must be viewed as a complete system. The ports would be useless without efficient waterways and intermodal connections to highway and rail links that allow the flow of traffic into and out of the ports. Likewise the MTS, as part of the bigger national transportation system, is our primary link to the rest of the world. Excluding surface trade with Canada and Mexico, 95% of our overseas trade, by volume, moves through our waterways. In a global marketplace, in which the United States is a primary player, this is critical for our economic security. Therefore, efficient and effective waterways management is extremely important.

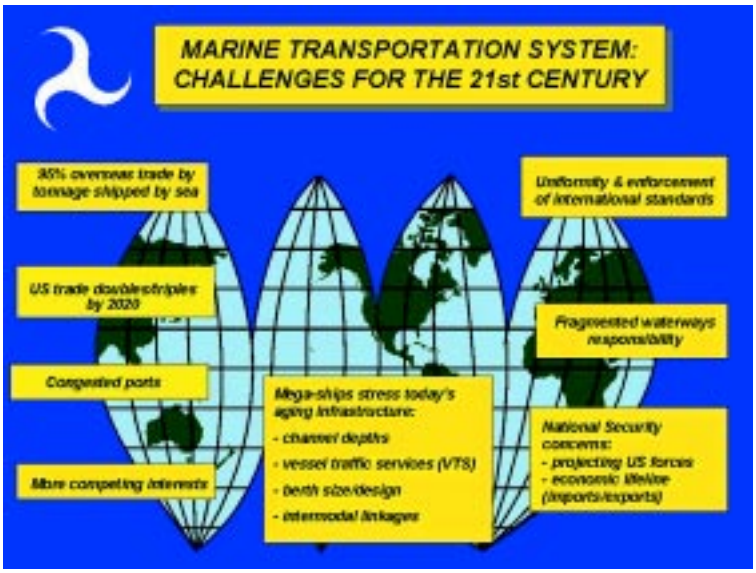
The strategic nature of transportation

In a recent report to Congress, Secretary of Transportation Rodney E. Slater clearly articulated the strategic nature of the Marine Transportation System and tied it to the President's National Security Strategy. He wrote in his personal preface to the report:

> "As the world's leading maritime and trading nation, the United States relies on an effective and efficient marine transportation system to further enhance our global leadership. In *A National Strategy for a New Century*, President Clinton calls for our renewed commitment to promote prosperity, enhance American competitiveness and invest in a world-class transportation infrastructure for the 21st century… As you know, this Nation was built on its waterways and ports. So we must make certain they are ready to compete, and win, in the global economy of the 21st century."

As a student and then later as an instructor at the Industrial College of the Armed Forces (ICAF), I learned about the strategic value of our transportation system as Secretary Slater points out. ICAF, a part of the National Defense University system, which teaches senior military and civilian Federal Government leaders about national security, had a course on "The Elements of National Power." This course was built upon the writings of authors such as Hans J. Morgenthau, who wrote *Politics Among Nations: The Struggle for Power and Peace*. These elements of national power include such things as geographic factors, natural resources, industrial capacity, size and education of the population, the strength of the military, national character, and transportation and infrastructure.

Figure 1.



To illustrate the value of transportation and infrastructure, ICAF instructors compared the United States with the former Soviet Union. While the Soviet Union enjoyed many of the same attributes as the United States (such as bountiful raw materials, large population, and strong military), it was clearly at a disadvantage in the area of transportation and infrastructure. The United States' highways, rail networks, and extensive natural river system, as well as well-developed ports and waterways, have always provided it with an ability to move goods and people within the United States as well as to foreign destinations. The former Soviet Union, on the other hand, did not enjoy the same kind of transportation infrastructure. We have all read or heard stories of food shortages in the Soviet Union at the same time that their crops were rotting in a field because they could not be moved to market. Transportation has a similar effect on mobilization and readiness. Clearly a well-developed transportation system provides a strategic advantage to any nation that possesses it.

Identifying the strategic environment

In the mid-1990s, the Coast Guard's senior leaders decided that they it needed to look further into the future. They commissioned a study by the Center for Naval Analysis. This study, along with some additional analyses, eventually led to the development of a publication called *Coast Guard 2020*. This effort to define the strategic environment considered the potential world of the future and identified areas that would be of strategic importance for the organization. It also forecast several trends in the maritime environment. These trends included the potential for doubling or tripling of trade by 2020 and the resulting pressures to increase the size and speed of ships, congestion in ports, competition for use of the waterways, and potential security concerns.

In April 1997, the Commandant at the time, Robert E. Kramek, used this information to write an article, "Management of the Waterways—A National Responsibility" for Marine Technology. He also briefed the Secretary of Transportation and then President Clinton to bring attention to the issue. Figure 1 is a copy of the slide the Commandant used to brief the president. He did this at a CINC forum in which he had only five minutes and could use just one slide to tell the president anything he wanted the president to know. You'll note that the slide does not include any reference to traditional Coast Guard missions, such as search and rescue, drug interdiction, enforcement of laws and treaties, etc. While these are clearly very important to the Coast Guard, the Commandant felt that the president needed most to hear about the strategic importance of the Marine Transportation System

and the pressures that would be brought upon it in the future. The Commandant concluded that if we do not address the challenges shown on the slide, the following consequences will occur:

- Reduce competitiveness for U.S. products overseas
- Increase prices paid by U.S. consumers for goods
- Increase congestion, resulting in reduced safety and environmental protection
- Reduce national security from external threats such as terrorism and organized crime
- Inhibit our ability to project U.S. forces overseas in times of national emergency

Leadership in a strategic environment

As I mentioned earlier, the DOD senior service schools, such as ICAF, teach their students about national security strategy to prepare them for future assignments dealing in the strategic environment. At ICAF, one of the core courses is "Strategic Leadership and Decision Making." While I was assigned as an instructor at ICAF, I had the opportunity to teach this course. I really believe in the old saying "If you really want to learn something, go and teach it." I'd like to share with you some of the things I learned about strategic leadership in the process of teaching this course. The SLDM course included lessons on self-awareness, negotiating skills, creative and critical thinking, and using information technology. All of these are very important parts of a strategic leaders' tool kit. However, I'd like to focus here on three of the other lesson areas of the course that are particularly applicable here. They are: Understanding the Strategic Environment, Vision and Alignment, and High-Performing Teams.

Understanding the Strategic Environment. One acronym developed and used by the Strategic Leadership and Decision Making (SLDM) faculty is VUCA. Any recent graduate of ICAF would be familiar with this term. Some of the seminars even used the term in naming their sports team, like the "VUCA Warriors." VUCA stands for Volatile, Uncertain, Complex, and Ambiguous. These are key attributes of the strategic environment. One of the main themes of the SLDM course is that leadership in the strategic environment is a little different than leadership at a more tactical level. This is one of the most difficult concepts for students at the senior service schools to accept. Almost by definition, every student attending ICAF or a similar senior service school has been a very successful leader. The basis of the SLDM course is that the leadership skills that made them successful prior to arriving at ICAF may not be a complete enough tool kit to operate successfully in a strategic environment. Because it is volatile, uncertain, complex, and ambiguous, strategic leadership requires some different tools or at least a different emphasis on some of the tools they've already employed.

Vision and Alignment. One of the most important elements of successful leadership at the strategic level is to have a clear vision and alignment of all the players. Because the environment has VUCA characteristics, there needs to be a clear understanding of where everyone wants to go—to determine a joint definition of what the end state is. Having a vision, a fixed point of reference off in the future, allows all the players to move in the same direction, despite the apparent uncertainty, volatility, and complexity surrounding them. The vision also helps to clarify ambiguous-appearing alternatives. Setting the vision and agreeing on the vision is one of the first steps for leadership in the strategic environment. While vision setting is also important at the tactical and organizational levels, the key at the strategic level is that the vision must represent a collaborative view.

High-Performing Teams. In my opinion, one of the most important elements of strategic leadership is this concept of high performing teams. The basic philosophy is that no one can go it alone in the strategic environment. There are too many players and too many agendas. No one person can be visionary enough, smart enough, or energetic enough to solve all the problems. If you look at the problems our world faces and see the solutions that have been developed, you'll see that no one leader, no one organization, and even no single country can solve them by themselves. The solutions require teamwork and, I would submit, a special kind of teamwork—the kind we see in high-performing teams.

Much has been written about teams and teamwork. We teach about it at our leadership schools. We talk about Team Coast Guard, and we believe in a philosophy that the team can make the difference. Many of the attributes of teams are pointed out with sports analogies. There's even a model to demonstrate the difference between the football team (with a single quarterback-type leader), a baseball team (where individuals almost take turns performing in their respective roles) and a basketball team (where the team needs to work cooperatively throughout the game). The problem with most of these sports analogies in the strategic environment is that they are based on a win-lose model. Some-

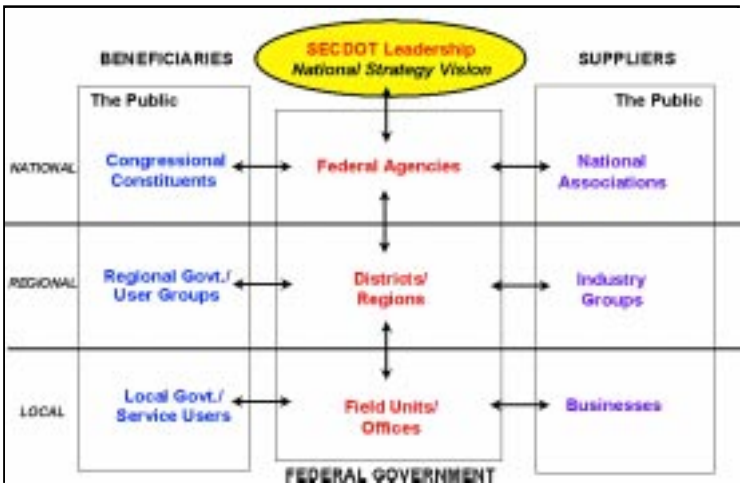


Figure 2: Relationship Model Government Role.

times the objective must be win-win.

The sports analogy that I prefer and have used before is a mountain climbing team. Consider the objective—the team needs to get to the top of the mountain. The competition isn't necessarily another team. It may be the elements, the environment. It may be a previous record, or it may be simply the challenge of being the first to get there. One of the attributes I like about mountain climbing is that the climbers are lashed together with a lifeline. If one member slips, the others catch the climber, re-stabilize the line and then go on. Another attribute is that the lead climber is frequently changed because the terrain is different or, like geese flying South for the winter, to ensure that no member is exhausted beyond his or her limit. In my view however, the most important attribute of this team sport is that the team wins only when everyone gets to the top of the mountain. Until that happens, no one has succeeded.

High-performing teams, as defined by the ICAF SLDM faculty, are a lot like my mountain climbing team. Some of the elements of high-performing teams are: a diverse makeup (diversity in points of view and ways of looking at the issue); an inclusive nature (ensuring that all players are involved in the solution); a collaborative process (ensuring that solutions will work for all parties); and shared responsibility and accountability. The last item needs a little additional explanation. Shared responsibility and accountability implies that all team members must be ready to take the point when they have to. It means that whoever understands the terrain the best, whoever can see a better solution, or whoever has the most energy (or resources) needs to be willing to take the lead. The others need to be wise enough to recognize this and follow the appropriate leader until such time as they have the most to offer and can take the lead. This kind of leadership requires a very mature group that shares the same objectives—the vision thing.

I would submit that Waterways Management and the Maritime Transportation System require strategic leadership. The environment in which they function clearly fits the VUCA model. There are many volatile, uncertain, complex, and ambiguous factors. There is a crying need for a common vision and alignment of all the stakeholders. Figure 2 is a schematic drawing that illustrates the complexity of some of the many MTS relationships. The solution lies in forming high-performing teams to get to the top of the mountain. If that's what we need, then how are we doing and where are we going?

How are we doing?

I have been blessed with an excellent game plan designed by one high-performing team, the WWM ESC. The WWM ESC was created to establish the vision for Coast Guard waterways management and to define the "end states" or our vision. The Committee did much of its work in three two-day off site annual meetings as well as several short-duration meetings targeted at specific issues. The team included several Flag Officers, SESs and senior Captains from Headquarters, supplemented on occasion with field representatives.

The first off-site meeting of the WWM ESC, in September 1997, established a vision, mission statement, and end states at both the national and local levels. The ESC also reviewed the work of the external and internal strategy teams. The second offsite, in July 1998, validated and refined the previous work and added an end state for the Coast Guard—the group identified what the Coast Guard wanted to achieve with its waterways management and MTS efforts. The ESC also defined a plan of action that became the basis for future efforts on the MTS in particular. Several targeted meetings of the WWM ESC were held to address specific issues like the agenda and objectives of the MTS National Conference and the creation of the MTS Task Force. The third off site, just held in August 1999, again validated the previous work, adopted a common definition of Coast Guard Waterways Management which encompasses both Operations (G-O) and Marine Safety (G-M) functions, and agreed to joint G-O and G-M planning.

If you look at the products of the ESC carefully, I think you'll see that the team clearly understood the complexity of the strategic environment, the importance of having a vision, and the need to work on this Commandant Imperative as a team. The Plan of Action also shows an understanding of the Coast Guard's role with respect to the other players in the bigger strategic environment of the MTS. "Help[ing] our federal, state, and local partners be successful" is the essence of being a good member of a-high performing team. So how have we done with MTS?

I think the entire community of MTS stakehold-

MTS VISION STATEMENT

"The U.S. Marine Transportation System will be the world's most technologically advanced, safe, secure, efficient, effective, accessible, globally competitive, dynamic, and environmentally responsible system for moving goods and people."

ers is also operating effectively in this strategic environment. The Coast Guard was not the only organization to see the value in teaming together on MTS. As you will read in Margie Hegy's article on page 10, one of the significant outputs of the National Conference on MTS was the creation of a consensus vision document. The MTS Task Force that produced the MTS report to Congress adopted that vision with very little change. As the co-chair of the MTS interagency working group, I can attest to the fact that the MTS Task Force was the model of a high performing team. The Task Force of over 20 federal members and twice as many non-federal members was specifically designed to ensure diversity in thinking. The decision-making process was both inclusive and collaborative. The members pulled together and truly shared responsibility and accountability.

I must admit that building this high-performing team was not easy. Building trust and mutual respect takes time and effort, but it can be done. In the early stages we had some skirmishes amongst the federal members, but we kept coming back to the vision and recognizing that we had common goals. When we reached out to include the non-federal stakeholders, we were frequently met with skepticism, at best, and cynicism, at worst, but we kept coming back to the common vision and common goals. In the end, we had developed enough faith in each other and had found the necessary sense of shared responsibility and accountability to pull it off. The defining event, the MTS Report to Congress, earned high praise from both the members of the Task Force and the Members of Congress who had requested it. Furthermore, the Task Force members, and especially the interagency team, have been cited for their unprecedented collaborative processes.

Where are we going?

The MTS initiative is moving forward nicely. The interagency working group has a lot of work to do in defining clear action plans for the future. Likewise the soon to be established non-Federal MTS National Advisory Council will need to continue to work together with common interests like a high performing team. I feel confident that we can maintain this momentum on MTS. So what does that mean for the Coast Guard and Waterways Management for the 21st Century?

People sometimes ask me, as the Director of Coast Guard Waterways Management, what my vision is for waterways management and the MTS. My answer is simple—I share the vision developed by the MTS Task Force (above). This is not just because I helped write it, but because I was a member of the team that worked through every word and saw the tremendous advantages of having all stakeholders aligned on the same target.

I admit that this statement, with nine adjectives, could be viewed as something less than elegant, but it covers the interests of the stakeholders and it works. Furthermore, the Coast Guard has a stake in nearly every adjective. Everyone can see our traditional concerns for safety and security, but are we really interested in efficient, effective, accessible, and globally competitive waterways? Of course we are! This is strategic stuff—remember, it is part of our national security strategy.

There is nothing wrong with adopting this vision to guide the Coast Guard's waterways management efforts as well as our MTS responsibilities. If nothing else, it will keep us focused on the big picture and aligned with our partners. What we don't need are a lot of separate visions for the future. Clearly, Coast Guard missions and strategic goals will differ from our MTS partners, but we must share the same vision.

That is where I think we are going, and we need to align our waterways management efforts toward that target. As a practical matter this has already begun. For example, this vision is the basis for the newest version of the Marine Safety strategic goal on mobility. We have switched emphasis from "Eliminating interruptions and impediments…" to "Maximizing the availability of safe, efficient, and environmentally sound waterways for all users…"

A final thought on leadership

One closing thought on leadership for the 21st century. One of the best courses I ever took on leadership—and I have had a bunch—was at the Federal Executive Institute and taught by Dr. Warren Blank. His course was "The Science of Leadership and the Art of Gaining Followers." As the title implies, his view was that leadership is a complex thing, more like quantum physics and chaos theory than nuclear physics and the law of gravity. He had several thoughts on the art of gaining followers too because his premise was simple—you are not a leader unless people follow you. The good news in this theory, to which I subscribe 100%, is that you don't have to be at the top to be the leader. You can lead from the front, of course, but you can also lead from the middle and even from the rear if you have a superior idea and you can get people to act on it. I find this entirely consistent with the ICAF concept of the high performing team. I also believe it is the model we will follow for waterways management leadership for the 21st century.

Historical Overview of Coast Guard Waterways Management

By Margie Hegy, Special Assistant to the Director of Waterways Management, USCG Headquarters, Washington, DC

Managing our nation's waterways is not a new concept. You might even say that "waterways management" started in the United States in 1789 when the first Congress authorized the construction of lighthouses and other aids to navigation in our waterways. Congress recognized the importance of our waterways then and took responsibility for ensuring safe navigation. Over the years, Congress increased federal responsibility through additional legislation, more often than not, as a reaction to a mishap. A majority of the authority was given to the Coast Guard, the federal agency with primary responsibility for waterways management. This article will provide an historical perspective of waterways management in the Coast Guard organization and explain why there is renewed national interest in this "old" issue.

In 1972, Congress passed the Ports and Waterways Safety Act (PWSA), which basically expanded the Coast Guard's port security authority to manage ports and waterways to include port safety functions, including "marine traffic management." In anticipation of this legislation, the Coast Guard established the Office of Marine Environment and Systems (G-W) in 1971. After a series of waterway accidents in 1976 and 1977, Congress amended the PWSA with the passage of the Port and Tanker Safety Act of 1978 (PTSA). With the expanded navigation safety and environmental protection authority, the Coast Guard consolidated all waterways management-related functions under a single program manager, G-WWM.

Waterways management started in the United States in 1789 when the first Congress authorized the construction of lighthouses and other aids to navigation in our waterways.

In 1986, the Offices of Marine Safety and Security (G-M) and G-W merged and waterways management functions were moved to the Office of Navigation Safety and Waterways Services (G-N). Waterways management was created as a program in the Navigation Safety Systems Division (G-NSS), yet many waterways management legal authorities remained in the Port Safety and Security Division (G-MPS) of G-M. In the field, waterways management became split between the Marine Safety Offices, Group Offices, and District Aids to Navigation Divisions (oan). Waterways management was further dispersed in 1988 when Headquarters restructuring eliminated G-NSS. In a 1996 streamlining, G-MPS functions were redistributed and the majority of G-N merged with the Office of Operations (G-O). The Vessel Traffic Services Division (G-NVT), which now included vessel routing and Rules of the Road, was moved to G-M.

A number of Coast Guard studies, beginning with the 1990-1991 Maritime Emergency Preparedness and Waterways Management Panel (commonly referred to as the "Ecker Study"), were initiated to review the causes of vessel accidents in our nation's waterways. Many causes were external to the Coast Guard. The studies pointed to increasing congestion and outdated channels, and fragmented, often uncoordinated waterways management responsibilities spread over a number of agencies, each operating with its own set of rules, resources, and objectives.

This resulted in inefficiency, a non-systematic approach, and even inaction. For example, the 1993-'94 HSC 2000 study looked at dozens of National Transportation Safety Board recommendations concerning the Houston Ship Channel that had never been acted on because responsibility was spread over different agencies. Significantly, the studies pointed to the lack of Coast Guard internal management and coordination of waterways management functions. A recommended solution was central Coast Guard coordination of waterways

management.

At this point, you are probably wondering what action resulted from these studies. G-N created a Waterways Management Quality Action Team to focus on coordination of waterways management issues within Coast Guard Headquarters. G-N also took the lead in 1993 to create an Interagency Committee for Waterways Management (ICWWM) to coordinate waterways management issues with other responsible agencies.

You are probably also wondering what is bringing waterways management back into the limelight. At least part of this recent emphasis began with a February 1997 Center for Naval Analysis (CNA) report titled: *Looking out to 2020: Trends Relevant to the Coast Guard*. The study, requested by the Coast Guard, highlighted profound change and growth in navigation technology and marine traffic over the next two decades. This resulted in another Coast Guard study by an internal Natural Working Group whose findings were published in an April 1997 report titled: *America's Waterways Transportation System. Moving from a Coast Guard Waterways Management Concept to Achievement of a National Waterways Management Vision.* This report convinced the Commandant that the nation and the Coast Guard needed to do something about waterways management.

The Commandant approved a Waterways Management Project Development Staff (G-M-2), now part of the Waterways Management Directorate (G-MW), to coordinate the efforts internally. A senior level Waterways Management Executive Steering Committee was created to provide strategic oversight to this effort. They, in turn, chartered two teams, one to develop an external strategy and one to get the Coast Guard's house in order.

In November 1997, the Commandant of the Coast Guard took the message to the Secretary of Transportation, along with a plan, developed in conjunction with the Maritime Administration (MARAD), to address the concerns. The Commandant advised the Secretary that:

> "The United States is at a critical juncture with respect to its future. We know there will be increasing demand on our ports and waterways. We know that our waterways are already reaching maximum capacity. We also know that there is no coordinated federal and stakeholder plan in place to address this challenge. National leadership is needed now to ensure our waterways keep pace with the shoreside infrastructure. Failure to plan now for these challenges could reduce U.S. competitiveness and increase risks to safety and the marine environment."

In 1972, Congress passed the Ports and Waterways Safety Act (PWSA), which basically expanded the Coast Guard's port security authority to manage ports and waterways to include port safety functions, including "marine traffic management."

The Commandant also stressed that while national leaders have an appreciation for why the country needs a national transportation system to meet current and future needs, the marine component of that system is overlooked as well as undervalued. Secretary Slater directed the Coast Guard and the Maritime Administration to work with the numerous government agencies with responsibility for some aspect of the system, to develop a strategy to ensure that the marine transportation system—waterways, ports and their intermodal connections—did not become the weak link in our national transportation system.

In March 1998, Secretary Slater invited more than 70 marine industry and public interest group leaders to a rollout of the Marine Transportation System initiative. He also made a public statement revealing his commitment to ensure that the U.S. waterways, ports, and their intermodal connectors could meet the challenges they will face as we move into the 21st century.

The process began with the Coast Guard, MARAD, and 12 other federal agencies hosting regional listening sessions in seven U.S. port cities. From March to May 1998, the seven two-day regional listening sessions were held in New Orleans, Oakland, New York, Cleveland, St. Louis, Charleston, and Portland, Oregon. Each meeting allowed users and stakeholders to voice what they believed the current state of the MTS was and what its future needs would be. Approximately 500 people attended the seven sessions. There were hundreds of comments and recommendations. The participants were supportive of the MTS initiative and commented that it was the first time they had seen so many federal agencies at the same table listening to their concerns.

The recommendations from the regional listening sessions became the basis for the agenda of a National Conference on the Marine Transportation System in November 1998. Secretary Slater hosted the two and one-half day conference that was attended by 144 senior leaders from government and

the private sector. Through breakout groups and plenary sessions, executives from industry, labor, and government addressed the following: (1) a national vision of the MTS; (2) a framework for national and local coordination mechanisms; and (3) five issue areas leading to goals and recommended actions on: safety, security, environment, infrastructure, and competitiveness.

After the National Conference, the Secretary established the Congressionally mandated MTS Task Force to assess the adequacy of the nation's MTS to operate in a safe, efficient, secure, and environmentally sound manner. The Task Force, which was co-chaired by the Coast Guard and MARAD, was comprised of 23 public and 44 private sector representatives of the MTS community. The results of the Task Force's assessment were reported to Congress in September 1999 in a report entitled: *An Assessment of the Marine Transportation System.* The Task Force identified seven strategic areas for action: coordination; funding the MTS; MTS competitiveness and mobility; improving awareness of the MTS; information management and infrastructure; security; and safety and environmental protection. The report does not present solutions, but rather a road map for evolving the current MTS toward the MTS desired in 2020.

The April 1997 report titled "America's Waterways Transportation System. Moving from a Coast Guard Waterways Management Concept to Achievement of a National Waterways Management Vision" convinced the Commandant that the nation and the Coast Guard needed to do something about waterways management.

Lighthouses, once a huge part of waterways management, have been eclipsed by electronic means, such as global positioning system. USCG photo by PA2 Tiffany Powell.

The MTS Initiative has been a highly successful collaborative effort to date. A primary goal of the Initiative was to put the MTS on the national agenda where it needs to be, if it is to continue to meet the increasing demands it faces. The real work lies ahead in continuing the partnerships that were created and to work together to resolve the issues raised at the regional listening sessions and implement the recommendations of the MTS Task Force. Key follow-on actions that are underway include:

- Expanding the existing Interagency Committee for Waterways Management and re-chartering it as the Interagency Committee for the MTS.
- Establishing an MTS National Advisory Council of private sector members that reports to the Secretary of Transportation.
- Encouraging the establishment of local stakeholder committees such as Harbor Safety Committees
- Developing specific action plans based on the recommendations of the MTS Report.

Even though the Coast Guard (and its predecessors) has been managing our nation's waterways for over 200 years, there are still new challenges. The MTS Initiative has identified the key issues that are important to the waterway users and developed a structure for coordination. The next step is getting down to the business of working out solutions that are acceptable to the multitude of public and private entities that share responsibility and ownership of the system. The Coast Guard is up to the challenge and looks forward to working with MARAD, NOAA, USACE, EPA, and our other Federal agency partners, along with the private sector. Together, we will take the appropriate actions to ensure that the challenges are met.

Waterways Management: A New Coast Guard Business Line

By CAPT Mark Johnson, Chief, Office of Policy and Planning, Waterways Management Directorate (G-MWP), USCG Headquarters, Washington, DC

The Marine Transportation System (MTS) Task Force has a vision: The U.S. MTS "will be the world's most technologically advanced, safe, secure, efficient, effective, accessible, globally competitive, dynamic, and environmentally responsible system for moving goods and people." Turning this vision into reality is the focus of the Coast Guard's newest business line, waterways management. It's a complex business line because the Coast Guard has only part of the federal authority and responsibility needed to move the system toward its vision. There are also the large private, state, and local pieces that make up the vision's pie, whose amalgamation with the federal piece will result in the heady end state envisioned for America's waterborne transportation.

Complexity notwithstanding, the Coast Guard is the agency best suited to assume the lead coordination and facilitation role in the MTS's development. Armed with powerful statutory authority under the local manifest of the Captain of the Port, the Coast Guard can direct the movement of any vessel on the navigable waters of the U.S. Additionally, the Coast Guard has broad oversight of the safety and security of the terminals to which ships and barges moor; manages the nation's aids to navigation system; oversees the environmental protection of our ports and waterways; ensures the safety of passengers; and supervises the transfers of dangerous cargo.

But, these are not new responsibilities that coincide with the MTS initiative. Some have been in place for over 150 years. What then, is unique about this business line that has organizational shifts occurring within the Coast Guard?

What is unique is the fact that waterways management is being viewed as a business line, not a program. It draws across the Coast Guard's two operating entities—Marine Safety and Environmental Protection, and Operations—in an attempt to capture Coast Guard contributions to mobility. When viewed as such, the Coast Guard appears to be changing its historical position overseeing commercial shipping and ports. The new business line, in response to the MTS initiative, commits the Coast Guard to improving maritime commerce while maintaining its traditional responsibilities to safety and the environment. For twenty years, the Coast Guard has struggled with its internal direction to facilitate commerce—sometimes at the expense of safety or the environment. Resultant accidents drove the agency's pendulum the other way—less facilitation, tighter oversight.

Implementing the MTS initiative may be the greatest challenge. Not content with facilitation, it speaks to national competitiveness, information sharing, aggressive research and development, and harmonized stakeholder coordination. Attention is again focusing on national security, environmental sustenance, and basic safety. Additionally, the Coast Guard will come up in the funding debate because decisions have to be made on the proper mix of public and private underwriting of infrastructure costs.

What can the Coast Guard do to ensure the MTS vision is achieved in the next few years? Internal business plans now contain a mobility mission goal, and a port security mission goal to match traditional aids to navigation/bridge administration goals. Understanding the MTS's economic value, causes of interruptions, and impediments to mobility, and their impact on the economy are first steps. The Coast Guard knows that time is money in maritime commerce. In fact, Captains of the Ports' judicious use of demurrage is more effective at correcting safety and environmental deficiencies than civil penalties. But, without knowing the root causes of mobility impediments, prudent federal interventions cannot be made.

Second, formalizing one of the Coast Guard's strengths within a port (that of a facilitator among stakeholders trying to achieve common goals), Captains of the Port will attempt to leverage the knowledge, resources, and authorities of a region's diverse participants. Using forums such as local harbor safety committees, the Coast Guard will seek to identify local mobility impediments, safety and environmental risks, and security vulnerabilities and coordinate local remedies among stakeholders. This local activity links with national coordinating bodies, the Interagency Committee on the Marine Transportation System (government), and the MTS National Advisory Council (private) in a systematic channel of national policy in response to collective local issues.

Taking this approach a step further, the Coast Guard's adoption of risk-based decision-making guides local ports through a probability vs. consequence analysis of safety, environmental, and mobility threats to the MTS. The Coast Guard is developing decision support "tool kits" to pinpoint problems that can be identified and corrected when all the stakeholders participate. Used under a harbor safety committee's aegis, resources can be directed toward impediments that can lead to low probability-high consequence results or high probability-moderate consequence results. Repositioning aids to navigation, reassessing pilot boarding areas, mitigating fog impact on ship traffic, traffic separation, and high-speed craft are some of the areas ripe for review.

The business line approach is important for an-

other reason. The Coast Guard is organized along operating and support programs, allowing for a parochialism that runs counter to the very cooperative initiatives noted. Internal organizational alignment is a key to ensuring that the Coast Guard's contribution to MTS is successful. Two approaches to this alignment can be taken: (1) consolidation of mobility and port security elements under a single directorate; or, (2) accountability among different programs to coordinate themselves to ensure MTS success. This latter approach spawns a dual loyalty and is somewhat more difficult to implement, but less disruptive organizationally. The Coast Guard has straddled the issue by doing a little of both. It has created a separate Waterways Management Directorate under the Assistant Commandant for Marine Safety and Environmental Protection, led by a Senior Executive Service director. This has pulled together disparate organizational elements within the Marine Safety and Environmental Protection program and slingshot them forward toward MTS vision achievement. Ironically, there used to be an Office of Port Safety and Security in the Marine Safety program that had many of the new directorate's responsibilities. It was disbanded five years ago during agency reorganization. A dynamic organization learns from its mistakes.

Much closer cooperation between the Waterways Management Directorate and offices under the Assistant Commandant for Operations that have mobility impact—such as the Office of Aids to Navigation, the Office of Boating Safety, and the Office of Bridge Administration—is already occurring.

This becomes more critical because the waterways management business line emphasizes precision navigation systems, vessel traffic services and vessel traffic information systems, electronic charting, and real-time navigational and environmental information available to arriving and departing ships and tows. As waterways become more congested with a combination of cargo and passenger vessels, and a burgeoning recreational boating population, vessel traffic management's role among local risk-based decision making bubbles in importance. From a Coast Guard perspective, these systems require cross program coordination coupled with federal interagency cooperation and private investment. The business line approach makes success more likely.

At the MTS regional listening sessions, it was stated that there was inadequate waterway infrastructure to accommodate today's traffic in some ports and waterways, let alone 2020's expected size and volume. The Coast Guard has historically contributed to a waterway's infrastructure through bridge siting and construction requirements and local aids to navigation. Dredging and facility construction or modification along a waterway received less Coast Guard attention. Adopting a safe position that dredging and permitting weren't direct responsibilities of the agency, future infrastructure development was not high on the Coast Guard's priority lists.

Adopting a business line that seeks to implement the MTS recommendations changes the paradigm. Infrastructure improvements to enhance mobility will occupy Coast Guard attention at both national and local levels, as the mobility enhancements are passed through safety and environmental protection screens. Further, planned navigation improvements require that all infrastructure be viewed from a systems perspective, because changes to one part of the system necessarily affect another. No new authority flowed to the Coast Guard as a result of the MTS initiative, but new responsibility to achieve the MTS vision changes the Coast Guard's point of view. System facilitator and coordinator pair with enforcer as roles of equal predominance in the new business line.

Twenty percent of the recommendations from the MTS Report involve enhanced port security, reflecting a changing, more dangerous world and the current U.S. military strategy of force projection. The challenge to the Coast Guard and other agencies with security responsibilities is to improve security without negatively impacting mobility. This is a monumental challenge that starts with an assessment of the MTS's vulnerability. To reduce that vulnerability without slowing cargo or people flow requires exploiting new technology and intelligence sharing. To the greatest extent possible, risk should be carried away from the terminal and port, thereby reducing the impact on the greatest number of people.

This mission also crosses traditional Coast Guard programs. The business line responsibility drives coalescence around military outload safety and security, counter-smuggling efforts, and anti-terrorism initiatives. Working through stakeholder units such as local port readiness committees and harbor safety committees, Captains of the Port and Group Commanders will seek to ensure that shoreside and waterside security fits seamlessly with Army and Navy outload components. Working with other law enforcement officials, Coast Guard units will partner with ship and facility owners to close vulnerability gaps to criminal and terrorist activists.

Absent a business line approach, it is unlikely that Coast Guard waterways management could accomplish what is needed to achieve a significant piece of the MTS vision. Success in this area may presage other business line approaches for the Coast Guard. This approach allows the service to marshal the best of its resources—regardless of their functional diversity—and direct them to overcome historical impediments while capturing the changing technology of today. It is an exciting opportunity and a critically necessary responsibility.

Waterways Management and PTP: Safety in the Marine Transportation System

By LT Scott Calhoun, Human Element and Ship Design Division (G-MSE-1), USCG Headquarters, Washington, DC

- 200-300% increase in tonnage of domestic and international marine trade over the next twenty years
- 65% increase in annual recreational users—130 million by 2020
- 6.5 million cruise ship passengers by 2002
- Rapid growth in high-speed ferry transportation
- Increase in commercial fishing

These are examples of the challenges that face the U.S. Marine Transportation System (MTS). Failure to accommodate these demands will likely result in a significant decline in our position as a leading maritime and trading nation. There are also increasing environmental concerns and most importantly, uncertainty about **safety**. We as a maritime community, currently stand boldly facing our future, actively searching for an answer to the question, "How can we ensure that safety is the primary consideration when addressing the challenges that face the MTS?"

The Prevention Through People (PTP) approach to marine safety provides the maritime community with the ability to honestly address this question through the application of PTP principles to waterways management. The PTP approach to marine safety focuses on the root cause of most, if not all, marine casualties—the human element. Addressing human and organizational factors is a critical part of assuring the success of our future MTS through the establishment of effective waterways management. U.S. waterways are going to see larger and faster ships, an increasing number of transits, more hazardous cargo, congestion in key ports due to multiple-purpose users, and increasing environmental concerns. Accommodating these needs, and doing so safely, can only be accomplished if the maritime community is absolutely committed to making improvements in marine safety that are in-

line and on par with changes in the MTS.

The Coast Guard makes every effort to share information with mariners. It helps improve safety for everyone in the maritime community.

PTP: Not a senior executive management fad

It is absolutely necessary that human and organizational factors be adequately addressed throughout the MTS and in any future developments in waterways management. Ensuring that improvements are being concurrently made in both the MTS and its safety system can be better achieved by acknowledging the important role of the PTP approach in waterways management.

Part of using the Prevention Through People approach is ingraining its five guiding principles into the culture of the Coast Guard and the marine industry:

1. Honor the Mariner
2. Manage Risk
3. Seek Non-Regulatory Solutions
4. Take a Quality Approach
5. Share Commitment

Honor the mariner: The vital link to the future

Improving the MTS and effectively managing our waterways requires an evaluation and assessment of how the marine community operates. The outcome of this will have greater value if we get into the nitty-gritty of the day-to-day workings of the waterways. The single most valuable resource in this process is the mariner.

Relationships among mariners, at every level, must be furthered and continuously improved as we seek answers to the questions of how to make waterway operations safe. A strong partnership with the maritime community allows federal, state, and local agencies to openly work together to identify hazards and evaluate risks. Without this ability, the maritime community is more likely to seek short-term technical solutions without adequately addressing the long-term human and organizational factors.

There are numerous opportunities to work together on safety issues. This happens mainly through the sharing of information within the maritime community. The Coast Guard has worked hard to identify and take advantage of these unique opportunities. Some successful examples have included Marine Safety Office (MSO) Wilmington's Fishing Vessel Safety Program, facility self-inspection, and courtesy marina exam programs; MSO Miami's T-Boat days, fishing vessel days, and cruise ship days; MSO Buffalo's PTP Group of St. Lawrence River Stakeholders; and MSO Detroit's Small Passenger Vessel Operators Conference. All of these are examples of the Coast Guard working with industry to promote safety and well-being. These initiatives have allowed mariners to get together to discuss pressing issues and also to gather information and training that can be taken back to their day-to-day operations.

Seeking input from, sharing ideas and information with, and incorporating the mariner into waterways management and the MTS is critical. No one knows the mariner's job and the finer points of marine operations better than the mariner. Information obtained directly from mariners is especially important in identifying hazards and in risk-based decision making.

Manage risk: risk-based decision-making (RBDM)

Making decisions can be difficult in an environment where the potential for significant undesirable outcomes exists. Waterways management is an excellent example of this type of environment. The future

development of the MTS is going to involve countless opportunities for the maritime community to make good (and bad) decisions. RBDM is a process that, if used properly, can significantly improve the decisions made in waterways management.

The RBDM process "incorporates information about the potential for one or more undesirable outcomes to occur into a broader, systematic framework that helps decision makers make more informed management choices" (Coast Guard RBDM Guidelines). There are many applications for it in waterways management. RBDM can be used for establishing priorities, changing regulatory requirements, allocating resources, and monitoring port and waterway operations, just to name a few. RBDM used in waterways management can help answer several questions:

- Which ports and waterways require the most prevention and response resources?
- What types of port and waterway activities should receive additional Coast Guard attention?
- What are the emerging needs of a waterway and what must be done to accommodate them?

Seek non-regulatory solutions: An effective alternative

Implementing and enforcing rules and regulations is not always the most effective or efficient way to improve marine safety. In many cases, regulations only provide for short-term technical solutions and fail to adequately address the larger long-term issues associated with human and organizational factors.

Regulations form the basis for minimum compliance standards and will continue to have a strong presence in the marine industry. The PTP approach to marine safety encourages the use of non-regulatory measures to rise above this minimum and increase the standard levels of safety. Waterways management will benefit greatly from taking a non-regulatory approach to problem solving. The use of a non-regulatory solution is typically easier to integrate with existing practices and can be a very effective way of getting at the root of a problem. Non-regulatory solutions are also effective because they get the mariner intimately involved in the RBDM process and are better able to address specialized local situations and conditions.

The use of a non-regulatory approach also helps to manage risk by encouraging change within the culture of an industry. For example, changing the Coast Guard's culture from providing technical and regulation-based solutions to encouraging people-oriented solutions, albeit challenging, is proving to add more value to its approach to marine safety. Examples of this are becoming more common.

One example of using a non-regulatory approach is the recent publication of the Passenger Vessel Association Risk Guide. The PVA Risk Guide is available for use by passenger vessel owners and operators and provides guidance on evaluating proposed operations, surveying existing operations, and determining the effect of operational changes. The guide helps and encourages owners and operators to focus on safety and managing risk. Using this approach will prove to be extremely beneficial because it provides opportunities for creating ownership in the management of day-to-day operations, instead of being forced to comply with a large number of regulations.

Take a quality approach

PTP uses an extremely effective and vital approach to safety that can increase the effectiveness of waterways management—continuous improvement through constant feedback. Taking a quality approach to waterways management includes a feedback loop that encourages administrators to constantly evaluate and analyze the system. This loop allows them to quickly address problems and take appropriate action to devise solutions and make improvements.

Waterways management will have a greater impact on safety if there is the ability to evaluate and re-evaluate proposed and implemented MTS improvements. This ability creates the feedback loop that will allow the maritime community to continuously monitor the effectiveness and impact of improvements, while ensuring that equally effective improvements are made in safety.

Share commitment: Working together for the future

Managing our waterways, ports, and their intermodal connections is no one organization's job. The future of every aspect of the MTS community relies heavily on our ability to jointly succeed in meeting future demands. A concerted effort throughout the maritime community is absolutely essential. Doors need to remain open between the Coast Guard and the marine industry and vice versa.

The Prevention Through People approach to marine safety has an important role in waterways management and in assuring the future success of our MTS. Part of this success hinges on ensuring that improvements in safety are made that meet the expectations of the expanding MTS. Using the PTP approach in waterways management will increase its effectiveness because it ensures that human and organizational factors are addressed in marine safety. Ingraining and practicing the guiding principles of the PTP approach into Coast Guard culture, as well as throughout the maritime community, is proving to provide vast benefit and will continue to as we eagerly work to shape the future.

MTS Delivers Value

By Clyde Hart, Administrator, Maritime Administration, Department of Transportation, Washington, DC

Americans everywhere love businesses that can deliver a bargain, especially when they do so with maximum concern for this country's natural resources. The U.S. Marine Transportation System (MTS) does just that: it provides real value to consumers while husbanding the rich yet finite natural resources that are our birthright. Stewards of the Nation's MTS must walk a tightrope, balancing the desires of those who believe "the business of America is business" against others who resist any intrusion into nature's delicate handiwork. The Maritime Administration (MARAD), the Coast Guard, and about a dozen other federal agencies serve at the forefront in efforts to ensure that these legitimate yet oftentimes competing views placed upon our MTS receive fair hearing.

Before addressing the environmental value that the MTS provides Americans, it is instructive to first look at the larger picture. What value does the MTS—waterways, ports, and their intermodal connections—offer? We who gain our livelihood in this exciting world of commerce know that 95 percent of all overseas products and materials, by volume, reach or leave our shores through our ports and waterways. Unfortunately, many people do not stop to consider *how* goods reach their markets. And, because they do not consider this fundamental fact, they do not fully recognize the importance of the MTS. Permit me then to provide a thumbnail snapshot of the MTS to the casual observer. It will create interest in many people who are likely unprepared for some eye-opening facts.

Consider that more than two *billion* tons of both domestic and foreign commerce each year transit ports on the Atlantic, Pacific, and Gulf Coasts and our inland and intracoastal waterways. The harvest of consumer goods, raw materials, and food leaving and arriving directly or indirectly impacts some 13 million individuals. They contribute almost three-quarters of a *trillion* dollars to the U.S. gross domestic product. Whether one is talking consumer goods, such as automobiles, computers and textiles, raw materials (iron ore, coal, petroleum), or agricultural products (poultry, beef, truck vegetables, frozen foods), the lifestyle that we take for granted today would be severely impaired if shipments were cut by even one-fourth.

Hundreds of thousands of men and women earn their living delivering products by train, truck, and vessels. Longshoremen, shipyard trade and craft employees, marine pilots, freight forwarders, consolidators, manufacturers, retailers, truckers, railroad employees, fishermen, and government employees at local, state, and federal levels—these are simply some of our neighbors who have a direct, immediate connection with the marine mode of transportation. All of them contribute immensely to our nation's ranking as the economic giant in the international trade arena for both exports and imports. The collective daily efforts of each of these people, and many other participants in the MTS, combine to provide consumers with value in economic, national security, recreational, and environmental areas.

Clearly, the MTS is integral to our prosperity and security. Accordingly, we must ensure that its upkeep is a first thought, not an afterthought. Secretary of Transportation Rodney Slater challenged Admiral James Loy, Commandant of the Coast Guard, and me to lead the effort of working with other departmental elements, government agencies, and the private sector in analyzing how the MTS fits into the larger

national transportation system. Basically, the goal of the MTS Report was to clarify the issues that need to be addressed head-on if America's MTS of the 21st century is to improve, not merely tread water or sink due to decay and neglect.

The recently released (September 1999) Report to Congress, *An Assessment of the U.S. Marine Transportation System*, deserves everyone's review. The report notes major challenges confronting us. It was prepared by a blue-ribbon panel of experts from 44 non-federal entities who represent an inclusive cross-section of the system's stakeholders, as well as officials from the 23 federal entities, including the Maritime Administration, the Coast Guard, the Environmental Protection Agency, the U.S. Army Corps of Engineers, and the National Oceanographic and Atmospheric Administration. Pressing needs include growing levels of demand, shifting user requirements, infrastructure support, funding, environmental concerns, and increasing national security needs. And the Task Force members made several recommendations that have to be adopted in some fashion if the vision emanating from the MTS National Conference is to be realized. All of us pledged that the MTS we want in 2020 is one that is "the world's most technologically advanced, safe, secure, efficient, effective, accessible, globally competitive, dynamic, and environmentally responsible for moving goods and people."

All nine of these attributes are important, of course, but two that I would like to single out for specific attention are safety and environmental concerns for the MTS. The Coast Guard's safety and environmental protection responsibilities for the MTS are well known to readers of the *Proceedings*, as they exercise executive functions through statute.

We need to recognize, however, that the rapid expansion of trade and recreational opportunities—vital signs in themselves of the success of our current system—invite problems that must be addressed. The size, speed, and type of vessels and users of the MTS is changing; meanwhile, much of our infrastructure is not. Vessels are becoming larger, faster, and more varied. Vessel movement safety concerns are not restricted to oceangoing and waterway trade for commercial carriers. Recreational use of the MTS has been steadily growing, exacerbating the importance for operators to know basic navigation rules in congested areas. Increasingly, recreational boaters have attracted attention by compiling some less than enviable statistics. In 1996 more than 11,000 boats were involved in accidents, with more than 700 casualties.

Task Force members essentially noted three types of infrastructure-related safety issues. First, terminal/ship interface is appropriately named, describing the physical layout of a port terminal and its ability (or lack thereof) to accommodate varied ships and cargo. Aging facilities must be updated not only to attract cargo but also to ensure the safe mooring, loading, and unloading and transit of environmentally sensitive cargoes.

Second, dredging and channel design will play increasingly important roles as megaships become less rare and enter commercial fleets in increasing numbers. The potential for disaster increases unless safety plays a prominent role in any cost-benefit analysis of channel depths and widths.

Finally, information management and infrastructure must improve and become affordable to all mariners if the MTS is to remain safe in the face of burgeoning traffic increases. Instances where this has occurred include the Global Positioning System (GPS) technology that provides even novice mariners with superior navigation information. Unfortunately, not all safety issues are solved with a modest off-the-shelf investment. Crucial hydrographic and shoreline information containing real-time tide, current and weather information may spell the difference between an uneventful cargo transit and a chemical or oil spill with devastating effects on ecosystems. The movement in industry toward just-in-time deliveries in the past decade has intensified the need for timely, accurate information. Transport of hazardous cargoes on vessels whose maneuverability is constrained imposes heightened safety and environmental demands; MTS managers and operators are eager to employ additional technologies to bolster existing strict procedures.

Americans have long rejected the notion that safety and environmental protection cost too much. We recognize that they impose a price—sometimes it is truly a heavy one—but we as a nation have committed to paying those dues. Safety concerns such as ship channel configuration, port and terminal development and operations, interaction of vessel traffic including navigation in icy waters, and terminal operations and cargo handling are not subject to easy fixes. Substantial resources are demanded and must be found if the MTS is to continue to provide more than 250 billion Americans with the goods that make this nation the envy of the world.

Certainly the same is true for ensuring compliance with environmental regulations and statutes. Addressing pollution sources, combating the introduction of nonindigenous species through inadvertent transport on oceangoing vessels, and educating recreational boating enthusiasts of the consequences of inappropriate environmental behavior will not occur overnight. But occur it will.

We at the Maritime Administration, and our government and industry partners throughout the

Marine Transportation System, are determined that environmental quality will be central to MTS activities. Doing less risks endangering vital commercial and recreational fishing; it undercuts local, state, and federal efforts in wildlife conservation and habitat preservation. Our commitment to harmonizing environmental value with transportation and economic values for Americans has been unquestioned. Progress may sometimes appear to be impeded when commercial interests must be harmonized with other legitimate interests. An important component of providing environmental value, however, is to recognize the value of other natural, historic, and cultural interests that are fundamental to our communities and national identity.

The Maritime Administration has proven experience as a federal agency able to work effectively with governmental, business, and environmental interests. Our interests oftentimes overlap into ones shared by such agencies as the U.S. Army Corps of Engineers, the Environmental Protection Agency, the Fish and Wildlife Service, and the National Oceanic and Atmospheric Administration, to name a few high-frequency peer players in the environmental world. Environmental value means recognizing that while the cost of doing business includes accidental spills or collisions resulting in discharge of petroleum, chemicals or minerals reducing these risks is also a cost of doing business. No one can guarantee that environmental accidents will never happen, but all of us can redouble efforts to ensure that sound procedures are in place and are being followed daily. The frenetic pace of traffic, so characteristic on our waterways and at our busy ports, should not become a handy excuse for failure to implement existing procedures, or for failure to strive for cost-effective improvement.

Ships and barges own a praiseworthy statistic: they have the fewest accidental spills or collisions of all forms of transportation. Given that the merchant seamen manning these vessels routinely load and discharge millions of barrels of petroleum, and hundreds of thousands of tons of coal, grain, chemicals and a host of other products, this is the ultimate proof that MTS operators are committed to safe, environmentally sound procedures. Regretfully, human nature causes people to focus on the rare failures—the *Exxon Valdez* oil spill or the New Orleans Riverwalk incident—to the detriment of the thousands of uneventful, safe marine transports of cargo and passengers.

The MARAD environmental protection program seeks to enhance environmental protection and sustainable development in our programs and in the U.S. maritime industry. Protecting MTS users' safety and the environment will not be successful unless all stakeholders are active participants. A systematic approach to MTS safety and environmental protection requires coordination at all levels. Identifying safety and environmental risks begins at the local level and involves private and public sector stakeholders. MTS is downstream of homes, industries, farms, and rivers; accordingly, our environmental efforts will be undercut if we do not have an accurate understanding of point and nonpoint source pollution entering our system from non-MTS-related activities. Getting involved with local officials tasked to monitor such activity may be invaluable in accurately determining problem areas to be addressed.

Changing perceptions some MTS users have in vessel operation stands out as an area that promises to deliver important dividends in the safety and environmental arena. Vessel navigation, recreational boating and accidental discharges are three areas that are deeply influenced by the person at the wheel of a vessel. Marine pilots and Coast Guard personnel play pivotal roles in helping ensure that the integrity of the MTS is respected by adherence to applicable laws and procedures. I especially want to single out the Coast Guard's Prevention Through People initiative. This approach to marine safety and environmental protection is less focused on dusty maritime laws and more in tune with what common sense tells any reasonable observer of transportation activities—the driver is usually the strongest or weakest link in the chain of events that spell success or disaster.

It is worth noting that the environmentally sound transport of people and goods via ferry, rail, and oceangoing vessel relieves congestion in other transportation modes and reduces air pollution. Fast ferry systems signal an exciting alternative for some to either leave their cars in the garage or reduce total transit miles to work on roads. For years, ferries have played significant roles in public transportation in the states of Washington, Alaska, and Hawaii. Growth in the Atlantic seaboard and Gulf Coast regions in recent years is a promising signal that this is an industry that can help America reduce road and rail traffic congestion, thereby reducing environmental issues plaguing these modes. We are intent on not simply transferring environmental problems from one transportation mode to another.

MARAD is overseeing a project with a Pacific Northwest shipyard to produce a high-speed/low-wake ferry that will address much of the criticism currently leveled by some residents in the Puget Sound area against high-speed ferries. MARAD is also involved in a number of projects to advance clean engines and alternative fuels for MTS application. Once viewed by many as an odd means of commuting, ferries are becoming staples of the MTS,

as the 134 million tickets sold last year attest.

Three primary areas of environmental issues that industry and government must focus on and improve if we are to achieve the MTS 2020 vision include ship operations and vessel movements; port development and terminal operations; and dredging. Vessel discharges, spills, and groundings can result in minor or catastrophic damage to shellfish fisheries, even causing the closure of beaches. Whatever the source—oil, sewage, plastics, antifouling agents or paints—we have to continue our vigilance and apply a zero-tolerance attitude. The education of new MTS users—such as new boat owners unaware or unconvinced of the dangers of releasing untreated sewage from vessel toilets—must be renewed. Education and training are vital to ensure that even the most experienced of MTS operators remain well informed regarding recent developments in environmental practice.

Science can be a formidable ally in helping us address critical issues that confront us now and are likely to worsen in the immediate future. An exponential increase in trade in the 20th century over the previous one has made defeating the menace of invasive species and organisms transported in ballast water, cargo, and on hulls of vessels problematic for the short term. We recognize the seriousness of the problem, and we have turned to the scientific and naval engineering community to help us develop technologies that will reduce, if not eliminate, this significant threat to agricultural and natural resources.

Port development and terminal operations stand at the crux of the environmental challenges confronting us. Storm water and waste water containing sediments, chemicals, and debris are a fact of life and are unlikely to be resolved quickly or inexpensively. Port development actions such as pier construction and rehabilitation—critical to ensure economic health and future marketability—poses their own problems such as decreased wetlands, habitat loss, and poor water quality. Numerous diesel-operated vehicles such as forklifts, tractors, and front-end loaders, indispensable in cargo movement, contribute to air pollution.

Finally, dredging is an issue that is destined to become increasingly central to environmental efforts as tomorrow's ships increase in size and number and demands on our navigational channels increase. The competition to capture markets by having the deep channels required for megaships translates simply and inescapably into millions of tons of dredged material that must be disposed of in an environmentally safe manner. The USACE and the EPA will play vital roles in these efforts but clearly we will see this transformation directly impact efforts throughout the MTS. National and regional dredging teams are asking the tough questions now that will affect our priceless wetlands, estuaries, and fisheries.

I believe that all Americans deserve maximum environmental and safety value from their Marine Transportation System, value commensurate with the economic benefits so strikingly attained to date. Basically, that means our waterways and adjacent shorelines comprising the MTS must remain a national treasure. They are vital natural habitats for countless species of plants and animals. We must protect these fragile ecosystems and natural habitats even as we make needed improvements in today's MTS for our children tomorrow. We can improve on the 'brownfields' image that sometimes haunts our ports. Ironically, a tool for helping us address such problems can come from noncontaminated dredged material, which unused creates an eyesore.

Knowledgeable observers of the MTS will concur that effective action in the safety and environmental realm requires participation by all users—governmental, industry, and general public. The MTS Report to Congress that Secretary Slater endorsed in September has given us the best thinking available from top-notch transportation professionals. Now begins the laborious yet essential task of acting upon these recommendations. Absolutely crucial to following through with this work will be wrestling with the sensitive issue of funding. I remain confident that the sense of shared responsibility all MTS users have in the health of this system will help us reach agreement on how best to proceed with making the MTS 2020 vision a reality.

Standing the Watch

A VTS operator is the voice of safe navigation in the port.

By LT Ron Northrup and LTJG Mary Wysock, USCG Headquarters, Office of Vessel Traffic Management (G-MWV)

Vessel Traffic Services (VTS) provide surveillance of the nation's waterways 24 hours a day, seven days a week, 365 days a year. If you have not been in a port with a Vessel Traffic Service, then you may not know or appreciate the role of a VTS operator.

The Coast Guard operates nine Vessel Traffic Centers. They are located in Berwick Bay, Houston/Galveston, Los Angeles/Long Beach, Louisville, New York, Prince William Sound, Puget Sound, San Francisco, and Sault Saint Marie. Whether it's in a center with as few as five personnel or as many as 56, these operators are the voice of safe navigation in the port.

On a rudimentary level, VTS operates analogous to Federal Aviation Administration (FAA) air traffic controllers. A combined 206 military, civilian, and reserve personnel at the nine units diligently watch geographic displays and closed-circuit TV and communicate with waterway users to provide critical navigation safety information. While the FAA air traffic controllers direct airline traffic as a primary function, the VTS operator differs somewhat. VTS operators monitor vessel traffic, collect information about ship movements and inform mariners of relevant traffic information. Sometimes under the authority of the Captain of the Port (COTP), the VTS watchstander will relay

VTS operators diligently respond to vessel requests for information facilitating mobility and commerce of our nation's waterways.

VTS Radar, Communications, and Microwave Site at Potato Point, Prince William Sound, Alaska.

an order to direct a vessel's movement. These directions are normally focused on a desired result. An example would be, "Do not pass 6-mile point until the downbound vessel clears the area." Their job is primarily to provide recommendations that avert collisions, allisions, or groundings to enhance navigation and vessel safety, and to protect the marine environment.

On a typical day, a VTS watchstander may issue advisories, or respond to vessel requests for information on reported conditions within the VTS area, such as hazardous conditions or circumstances; vessel congestion; traffic density; environmental conditions; aids to navigation status (e.g. buoy off station); or other anticipated vessel encounters.

VTS operations cross all organizational and functional boundaries of the Coast Guard. The VTS provides a service to the local port community by providing mariners with general navigation information. The VTS acts as the eyes, ears, and voice of the COTP. It relays general navigational advisories and issues COTP orders. The VTS provides information about recent ship arrivals to Coast Guard Port State Control officers for possible inspection and examination of substandard vessels entering U.S. waters. It can assist Rescue Coordination Centers in the execution of search and rescue cases, as well as support law enforcement operations.

VTS personnel in Valdez, Alaska recently led a remarkable Coast Guard effort following a generator system casualty which resulted in the loss of a primary radar site at Prince William Sound's Potato Point. This remote site is strategically located at the Valdez Narrows entering the port and surveils the narrowest stretches of this one-way traffic zone.

When the Potato Point radar site went down, valuable safety-enhancing information was lost. A VTS watchstander was immediately deployed aboard an industry escort vessel to monitor tanker transits. The next evening, this watchstander position was shifted to the Coast Guard Cutter *Mustang* when it arrived on scene. They monitored safe transit of more than a dozen inbound and outbound tankers from these temporary platforms. All vessels completed normal transits without incident under the watchful eye of the Coast Guard on scene. Mechanical and electrical technicians from the Coast Guard Civil Engineering Unit Juneau and Marine Safety Office Valdez restored the site.

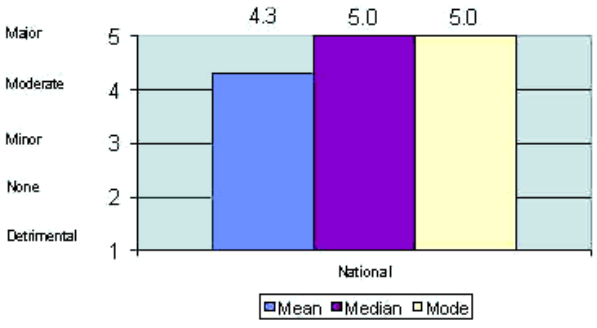
Although not the primary objective, this operation allowed for partial exercise of the unit's Y2K contingency plan. The loss of the radar site highlighted the versatility of VTS personnel and demonstrated the flexibility of VTS operations.

Watchstanders must be proactive as well as reactive to critical traffic management situations. The job requires an extremely high mental state of alertness and demands total concentration. For example, a VTS watchstander observed a recreational boat directly in the path of an outbound tug. The VTS watchstander notified the tug Captain of the possible conflict ahead. In another port, a vessel failed to execute the proper turn at the outbound dogleg in the traffic lane. The watchstander noted that the vessel was off course by more than 15 degrees, which would have positioned the vessel somewhere between the land and the most southern edge of the inbound traffic lane. This was averted because the VTS operator advised the vessel to alter course to safely complete his transit. These kinds of attentive interaction by VTS operators prevent incidents every day.

In a recent VTS Customer Satisfaction Survey, port stakeholders overwhelmingly agreed that Vessel Traffic Services are a major contributor to ports' safety record. The survey results can be found online at **http://www.uscg.mil/vtm/pages/custsat.htm**.

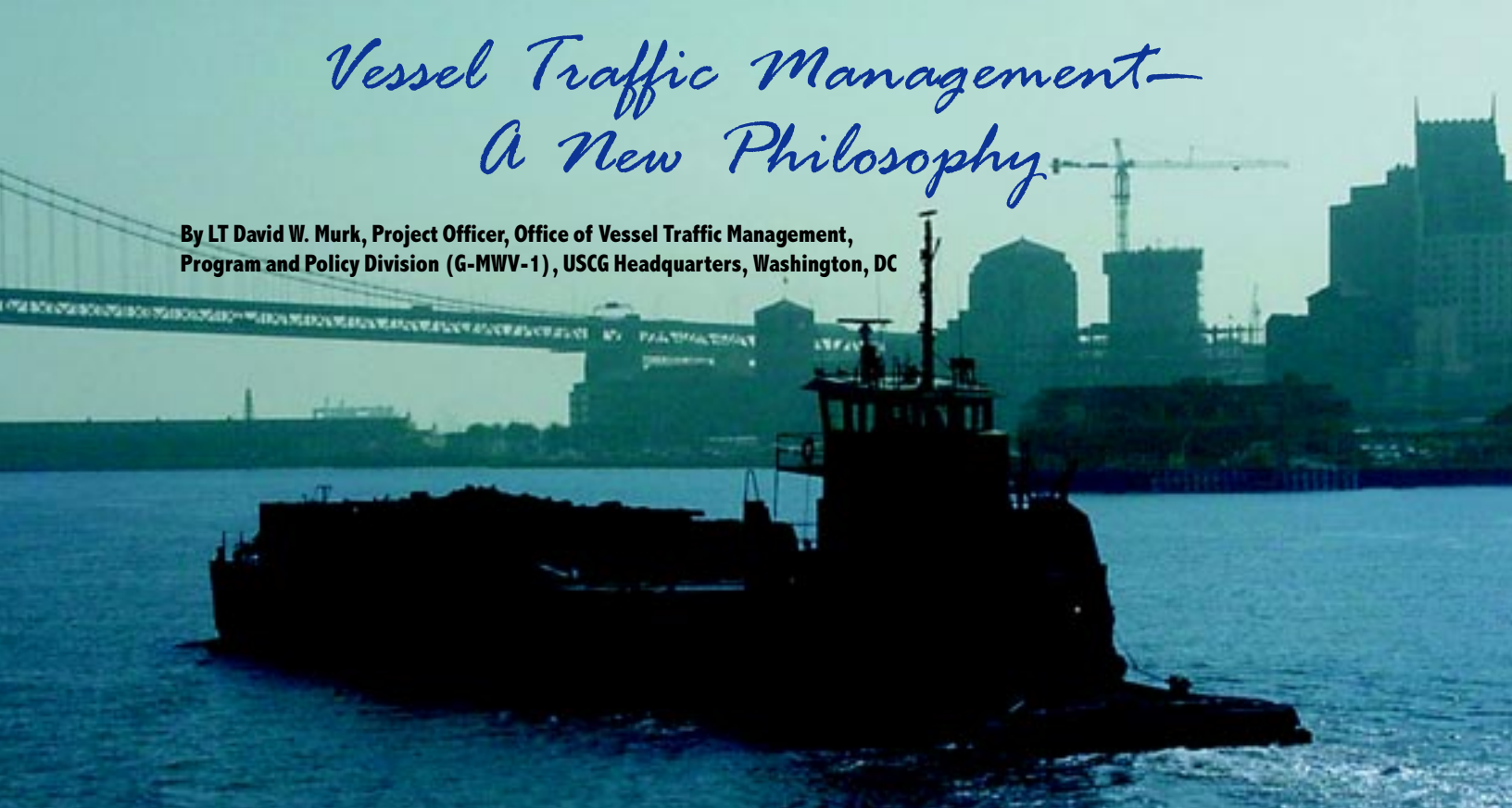
Nationally, VTS operators monitor the safe movement of approximately 20,000 vessels per month. At this very moment, dedicated VTS operators are hard at work around the country, ensuring the safety and mobility of our nation's waterways—they are standing the watch.

Question 31—In my opinion, the VTS/VTIS contribution to the port safety record is



Vessel Traffic Management— A New Philosophy

By LT David W. Murk, Project Officer, Office of Vessel Traffic Management, Program and Policy Division (G-MWV-1), USCG Headquarters, Washington, DC



Over the past three years, the United States Coast Guard Vessel Traffic Service (VTS) acquisition program has seen tremendous change, with a complete transformation of its approach to decision making and acquisition of VTS. Through the 1997 Appropriations Bill, Congress directed the USCG "to identify minimum user requirements for new VTS systems in consultation with local officials, waterways users, and port authorities" and also to review private and public partnership opportunities in VTS operations. As a result of this Congressional redirection, the Coast Guard established the Ports and Waterways Safety System (PAWSS) to address waterway user needs and place a greater emphasis on partnerships with industry to reduce risk in the marine environment.

Under PAWSS, the USCG immediately convened a National Dialogue Group (NDG) comprised of maritime and port community stakeholders to identify the needs of waterway users with respect to VTS systems. The stakeholders—representing all major sectors of the U.S. and foreign-flag maritime industry, port authorities, pilots, the environmental community, and the USCG—were tasked to: identify the information needs of a mariner to ensure safe passage; assist in establishing a process to identify candidate ports for the installation of VTS systems; and identify the basic elements of a VTS. The NDG was intended to provide the foundation for the development of an approach to VTS that would meet the shared government, industry, and public objective of ensuring the safety of vessel traffic in U.S. ports and waterways, in a technologically sound and cost-effective way.

From the NDG came a series of changes and the development of the Ports and Waterways Safety Assessment (PAWSA) established to open a dialogue with port stakeholders to determine candidate VTS ports. PAWSA provides a structure for identifying risk drivers and then evaluating potential mitigation measures through expert input from waterway users. The process requires the participation of professional mariners with local expertise in navigation, mobility, and port safety. In addition, stakeholders are included in the process to ensure that important environmental, public safety and economic consequences are given appropriate attention as risk interventions are selected. To date, eight U.S. ports have completed the PAWSA process, which has been a resounding success and well received by the local maritime community. The goal of PAWSA is not only to establish a baseline of ports for consideration for VTS, but also to provide the local Captain of the Port and port community with an effective tool to evaluate risk and work toward long term solutions to mitigate these risks. The goal is to find solutions that are both cost effective and meet the needs of the waterways user.

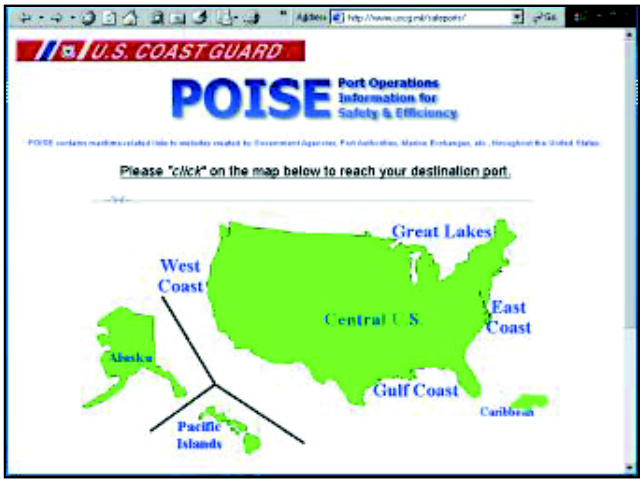
An emerging technology that continues to gain support in the U.S. and the international maritime community is the automatic identification system (AIS). The Coast Guard, in its devotion to leveraging technology to enhance mobility in U.S. ports, recognizes the benefits of AIS and has aggressively moved to implement this system nationally as rapidly as possible. AIS has the capability to exchange and display positional and other relevant data among participating vessels and shore components.

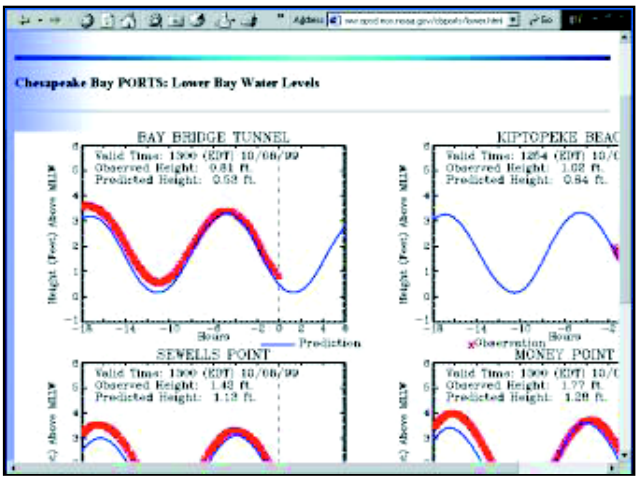
AIS is a voiceless, automatic, continuous transponder-based navigation safety system that operates via VHF-FM and enables the efficient exchange of data among ships and between shore stations and ships. AIS is intended to meet professional mariners' needs for timely, relevant, and accurate information delivered in an unobtrusive manner. As technological advances continue, the effectiveness of AIS continues to move ahead with key enhancements that provide the mariner additional critical information on weather and current data essential in safely navigating vessels through our waterways. The system will raise situational awareness and the safety foundation across the board. In addition, the Coast Guard plans to integrate AIS technology into VTS. An AIS-based VTS will allow situational processing/awareness to take place by an independent third party.

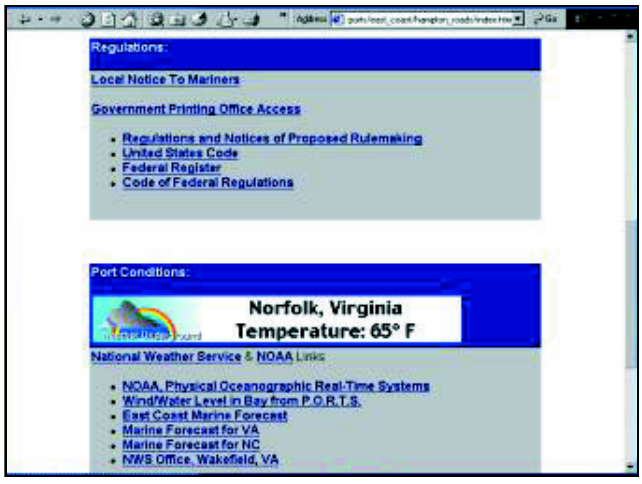
The Coast Guard has taken the first step in implementing an AIS-based system with the installation of VTS New Orleans. Presently, 50 transponder units are operational and being tested on vessels operating on the Lower Mississippi River. An additional 50 units will be purchased by the Coast Guard in FY2000 for testing to ensure effective communication in a ship-to-ship and ship-to-shore mode prior to its integration and operation as a voiceless communication source under the New Orleans VTS. However, a critical component to the overall success and effectiveness of AIS is a mandatory carriage requirement that targets the right mix of vessels. Mandatory carriage domestically is expected in two to three years based on approval and implementation of a universal carriage requirement by the International Maritime Organization, which would affect all vessels on an international voyage. For additional details about AIS-based VTS see "Ports and Waterways Safety System (PAWSS)" on page 26 and "The Future of Universal AIS: A 2004 Vision" on page 29.

Another Coast Guard initiative well underway in the realm of vessel traffic management is the Port Operations Information for Safety and Efficiency (POISE) Web site. POISE is a state-of-the-art link to specific ports and maritime related information across the nation. Organized by geographic locations, POISE is an easy-to-use, intuitive tool for the mariner. Mariners will only be required to remember one URL address (**www.uscg.mil/safeports**) to reach all available Web-accessible port and navigation safety information. Notably, POISE links to the National Oceanic and Atmospheric Administration Physical Oceanographic Real Time System (PORTS) Web site, providing the mariner with accurate real-time weather, current, and tide information for numerous waterways throughout the United States. POISE will be extremely useful to mariners and harbor pilots for voyage planning and accessing Coast-Pilot information. POISE will make it easier for the USCG to get important safety information into the hands of the people who need it in a timely manner.

POISE is a one-stop, Internet-based, port-specific information kiosk for voyage management information. The majority of the information in maintained by non-Coast Guard entities (state, federal and commercial).







Ports and Waterways Safety System (PAWSS): An Automatic Identification System-Based Vessel Traffic Services Acquisition with Emphasis on Partnering with the Maritime Community

By Sandra Borden, USCG Deputy Project Manager, Vessel Traffic Services Project Office, USCG Headquarters, Washington, DC

Background of Automatic Identification System

In 1989, the IALA VTS Committee developed a concept paper for an automatic identification system that involved "the use of a transponder system to permit ships to be identified and tracked when approaching, entering, or sailing within a VTS area." Their paper, which was submitted to the Sub-Committee on Safety of Navigation (NAV 36) at IMO in September 1990, described "requirements for a ship identification, polling, tracking, and automatic reporting system to operate in conjunction with VTS."

The Universal Automatic Identification System (AIS) has come to be known as a shipborne transponder-based navigation safety system that enables the efficient exchange of data such as name, type, position, course, speed, navigation status, dimensions, or type of cargo among ships and between shore stations and ships.

When coupled with an appropriate situation display, AIS provides navigation and vessel traffic information to the mariner. AIS meets the professional mariners' need for timely, relevant, and accurate information delivered in an unobtrusive manner. It is an autonomous, automatic, continuous system that operates in broadcast and interrogation modes in the VHF Maritime Mobile Band using self-organizing, time division, multiple access protocols.

Within a Vessel Traffic Service (VTS), AIS transponders will manage the exchange of data between vessels and the shore-based VTS. The VTS would receive signals from every transponder in range and transmit relevant information to participating vessels in the area. The VTS could also report up-to-the-minute water depths, weather, height of tide or other safety related information. Outside a VTS area, AIS transponders will work in ship-to-ship mode.

AIS as a vision

I recently met Bo Tryggö of Swedish Maritime Administration, who has been declared the Father of AIS by his maritime colleagues. We attended the September meeting of the IEC TC80 Working Group 8 AIS aboard the largest ferry in the world, *Silja Symphony*, in transit between Stockholm and Helsinki. He came to check the progress of finalizing the last standard needed to implement AIS as a vision for safer vessel navigation and better sharing of information. The setting was especially meaningful with the Baltic Sea being the site of one of the worst recent maritime disasters, the sinking of the ferry, the *Estonia*. Also, with us was Roy Lee of the United Kingdom, whose grandfather was a surviving seaman of the *Titanic*. Needless to say as a group, we are highly motivated to finish our work and to encourage operational demonstrations of the power of AIS.

With pioneers such as Bo in mind, this article will provide a status report of what the USCG has done to implement his vision, through the acquisition of AIS-based vessel traffic services and partnering with our stakeholders.

Implementing new technology

There are many far-sighted, highly motivated people in the maritime industry who appreciate that the times are changing, and opportunities abound. This has created a fundamental shift in the attitude of mariners, causing a demand for products such as AIS and common computer displays that are interoperable and provide information in an easy to assimilate manner. This in turn puts pressure on the international standards bodies to keep ahead of the technology maturation cycle to enable common shipboard equipment suites and operating procedures. The challenge is to expedite a standard to encourage the market place to deliver new products and yet ensure the standard is adaptable to future requirements. The same challenge exists for both industry and administrations to trade off immediate adoption versus waiting for the planning cycle to determine a well-thought out approach to implemen-

tation. The international standards bodies have expedited the process, and the last in a series of standards is expected to be in final draft in 2000.

It takes a crystal ball to determine when and how to acquire new electronic systems. It also takes frequent and interactive dialog with the maritime community and the other stakeholders such as the ports and environmentalists. This dialog needs to continue during the life of the system especially when establishing the operational procedures for using the system.

Dialogue with stakeholders

To successfully manage inserting new or different technology such as AIS in an operational setting, the users and other stakeholders have to be included in every phase of the process.

The USCG has planned and incorporated dialogue with the stakeholders in every phase of the project to acquire and to update Vessel Traffic Services. The very title of this acquisition project, Ports and Waterways Safety System (PAWSS), reflects the desire of the stakeholders to acquire a system that can provide safety to a community of ports and waterways.

In the concept phase of the acquisition, the USCG formed a Concept and Requirements Team (CART). The team included industry and government representatives chartered to breakdown stovepipes and think in a collaborative way to solve common problems related to vessel safety and protecting the environment from vessel accidents. The USCG acquired help for requirement development from two noted institutes: Software Engineering Institute (SEI) of Carnegie-Mellon University and MITRE. SEI had done extensive research in managing technology change, software quality control, and risk management. MITRE, a federally funded research and development center, was hired to serve as a system engineer because of expertise in a risk mitigation technique called evolutionary acquisition (buy a little, test a little, and repeat the process).

The USCG VTS acquisition project was able to form a beneficial partnership with SEI serving on SEI's Risk Management Advisory Board and providing case studies and material for textbooks. The project participated in a beta version of SEI's risk assessment tool and received valuable feedback on methods to mitigate risk (e.g., use of an operational test bed). Also, SEI provided "management of change" training to the CART. MITRE facilitated the CART meetings using collaborative decision processes and provided technology briefings. The participants were enthusiastic and willing to work long hours to understand each others' needs, develop potential scenarios of how to improve safety, and identify issues.

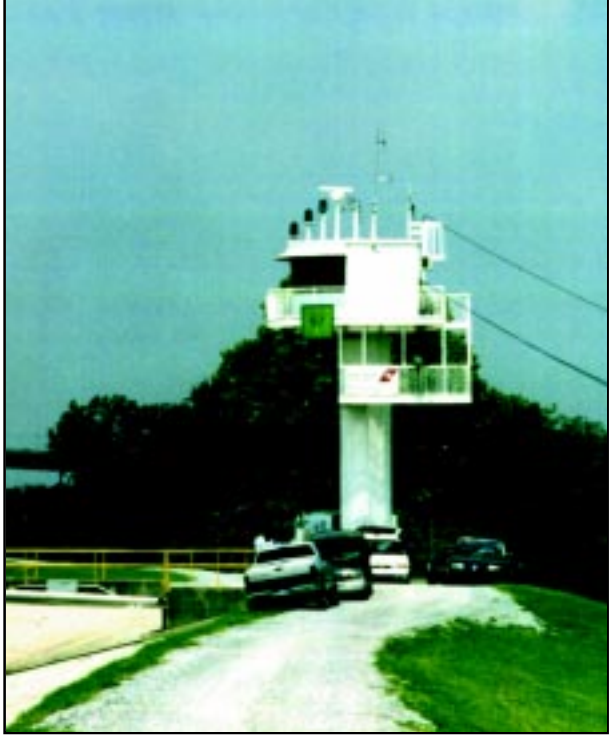
The CART reported a need for a "voiceless" or reduced-radio-traffic-based VTS, which we now call an AIS-based VTS. Unfortunately, there were many technological hurdles: lack of digitized charts, limited radio frequency band width, lack of a complete set of international standards, equipment interoperability concerns, and questions of which vessels were required to be equipped with transponders.

To wrestle with these issues and to clarify needs, two other groups met to provide formal guidance to the USCG: the National Dialogue Group (1997-1998)—composed of representatives of the American Association of Port Authorities, the American Pilots' Association, the American Waterways Operators, the Council of American Master Mariners, Intertanko, the Passenger Vessel Association, the Natural Resources Defense Council, the U.S. Chamber of Shipping, and the U.S. Coast Guard—and the Lower Mississippi River Safety Advisory Council (an existing federally chartered committee). Both these groups promoted the use of AIS, especially in a ship-to-ship mode. The ship-to-ship mode requires shore-side infrastructure when there are geographic features interfering with radio communications. This presented another technological challenge to be addressed in the PAWSS acquisition strategy.

To meet these needs, a cost-effective acquisition strategy was adopted that balanced cost, schedule, and technical performance risks. The strategy included these principles:

- Establish partnerships.
- Buy a commercially available Vessel Traffic Service system.
- Use an open systems methodology.
- Build each port and the system incrementally.
- Adapt to each port.
- Obtain dedicated support from the National Telecommunications & Information Agency to develop a radio frequency plan.
- Begin environmental impact assessments early.
- Use risk management techniques to handle trade-offs.
- Have an operational test bed on the Lower Mississippi River.
- Involve the mariners and port stakeholders in evaluating the system.
- Use an Integrated Product Team to encourage dialog between the developer and the user.

A PAWSS acquisition team visited 13 domestic- and international-installed VTSs as part of the market survey process to evaluate the feasibility of "commercial-off-the-shelf" systems ability to adapt to frequency challenges of the United States and the evolving international standards for AIS. After a for-



The initial test facility for PAWSS was established in October 1998 at the Gretna Traffic Light on the Mississippi River.

mal solicitation and an evaluation process that used oral proposals, a seven-year systems integration contract was awarded in April 1998 to Lockheed Martin to install the Vessel Traffic Services systems. Two other contracts were awarded to support the test bed: Ross Engineering for transponders and MariTEL Corporation for radio communications services.

The test bed was established in October 1998 with the system hub at the Gretna Traffic Light on the Mississippi River Crescent opposite New Orleans. The hub was moved across the river in July 1999 to the Vessel Traffic Center located at One Canal Place.

Five towers support voice and AIS radio communications along 285 miles of the Mississippi River from Baton Rouge to the mouth of the Mississippi River. Fifty-two transponders were issued to local mariners who volunteered. They signed formal partnership agreements to participate in a wide range of AIS and communication tests.

These tests are using an interim AIS standard and will identify frequency interference, coverage problems, and help establish operational procedures for the Vessel Traffic Center and the mariners. The system is capable of accepting 200 AIS contacts. The test participants continue to give the Coast Guard feedback and suggestions on how to improve the system.

The VTS subcommittee of the Lower Mississippi River Safety Advisory Council (LMRWSAC) is serving as the independent operational assessment agent and performed an initial assessment of the Vessel Traffic Services system against the stated needs. The results are contained in a formal report dated May 12, 1997. The subcommittee members viewed the system from both the shore- and the ship-side and agreed that the system could meet their needs.

Demonstrations

"Have transponder, will travel." The system can be demonstrated easily: in a simulation mode using just a transponder or remotely using live vessel contacts with a workstation connected by modem to the test bed hub. The test facility has played host to visiting delegations from many countries and to the members of a working committee of the Radio Technical Commission for Maritime Services, representing many countries. Also, the system has been demonstrated to the Western Hemisphere Transportation Ministerial Conference in December 1998 and at the National Transportation Safety Conference 1999. Both were hosted by the Secretary of Transportation, Rodney Slater.

This spring, the USCG plans to hold an iterative vendor demonstration of specific functions of the final AIS testing standard, with emphasis on frequency management and interoperability of transponders from different vendors. Vendors are being encouraged to participate and to enter the market. The maritime community will benefit from the increased competition. The schedule for mandatory carriage of transponders has been proposed by NAV 45 to be phased in from 2002 to 2005 by vessel class.

Partnerships

The USCG is seeking partnership relationships with port entities in VTS ports. On the Lower Mississippi River there are now three types of memoranda of agreement to share resources—with more expected. The Associated Branch Pilots and the USCG are sharing radars at two sites close to the mouth of the river. The Crescent River Port Pilots are going to provide a pilot to work in the Vessel Traffic Center. And there are agreements with the mariners who have volunteered to participate in the transponder tests.

Installation schedule

VTSs will be installed in increments, normally in two phases over a two-year period. The Lower Mississippi River VTS and the Prince William Sound VTS have completed phase one. The USCG is evaluating candidate ports for an AIS-based VTS using an assessment model with local mariners and port stakeholders involvement.

For more information

The PAWSS project home page, **http://www.uscg.mil/hq/g-a/avt/**, contains newsletters, vendor information, project documentation, and points of contact.

THE FUTURE OF UNIVERSAL AIS: A 2004 VISION

By Commander Ken Prime, Chief, Facilities Division, Office of Vessel Traffic Management (G-MWV), USCG Headquarters, Washington, DC

The U.S. Coast Guard views the development of international AIS standards as a significant milestone in reducing risk in the maritime environment.

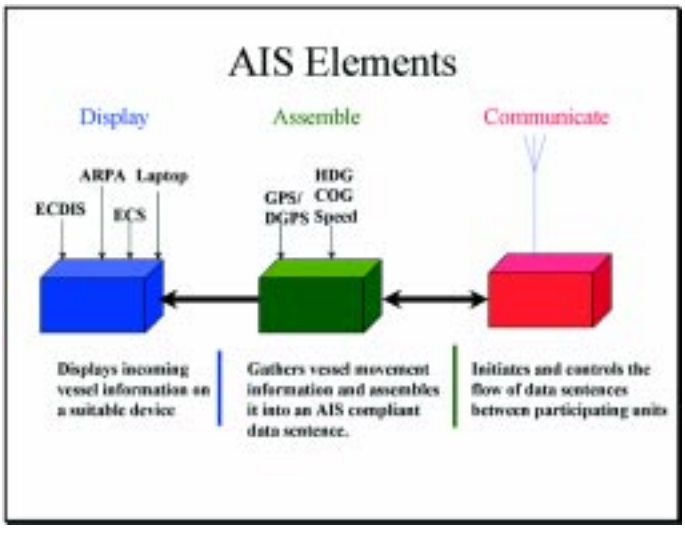
This article describes the Coast Guard's vision of an AIS transponder system that will provide seamless service to users in all areas; not just areas that are covered by a VTS. This includes both ship-to-ship and ship-to-shore-to-ship data exchanges. It further discusses the Coast Guard's efforts to develop Universal AIS standards and other efforts involved to provide a robust AIS that will meet the expectations of users.

DATELINE: COLDPORT, USA, FEBRUARY 1, 2004

The year is 2004; you are the Captain of the *M/V Clearsail*, underway from Europe bound for Coldport, USA. *M/V Clearsail* is equipped with an Automatic Identification System (AIS) transponder.

You click a button on the display system to observe real-time weather conditions at the port. The visibility conditions are under a mile. However, you electronically identify several other vessels also equipped with AIS transponders that appear as icons on your display system stating their name, course, and speed. Scrolling up the harbor, you quickly verify that all aids to navigation are watching properly as no discrepancies or Notice to Mariners are posted. Additionally, you click another button on the display to obtain real-time water stage and current data for specific places within the port to assess your expected under-keel clearance. As you pass the entrance channel marker, you continue your transit up-river and obtain river stage levels and real-time ice conditions for known choke points. AIS provides information so you can coordinate ice convoying activities. Your transit will take you beyond Coldport to the lock system. The AIS allows you to observe locking activity and obtain important sill clearance data and lock status. You discover the time to lock through is projected at 8 hours due to heavy ice conditions and the number of vessels already queued. You decide to reduce your speed and search for another berth in Coldport to await locking. You take on stores and parts in Coldport. After your logistics stop in Coldport, you continue on to the locks.

You safely and efficiently made your port call. Receiving data in advance aided your trip planning by giving appropriate information on important operations and helped coordinate port arrival and stevedore services. All of these functions can be completed without the need to transmit over VHF-FM. AIS gives the mariner the unique ability to obtain vital real-time port information much sooner than before, thereby improving the master's overall situational awareness—all with the click of a computer mouse button on a bridge display.

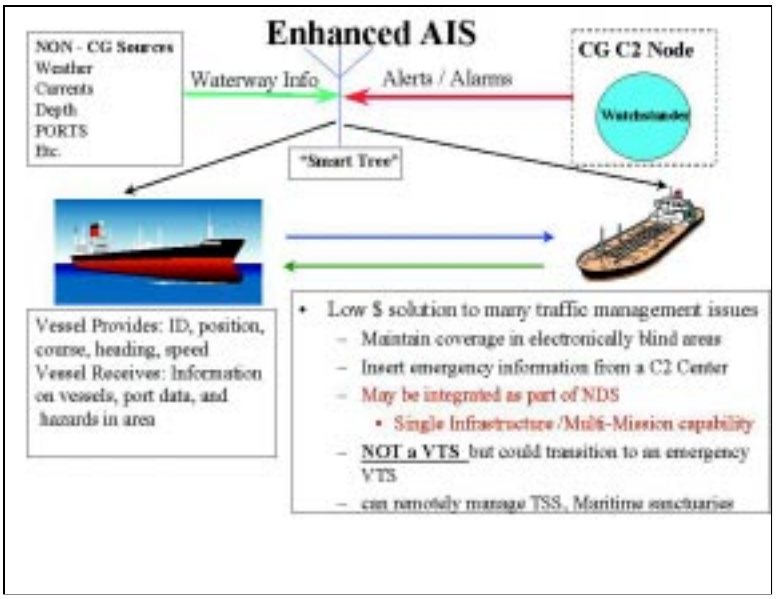


AUTOMATIC IDENTIFICATION SYSTEM (AIS) POTENTIAL

AIS presents an opportunity for users to exchange and display positional data between participating vessels and with shore components. AIS has the ability to raise the safety foundation for all participating vessels by providing coverage in all areas, not just in a VTS area of responsibility. The Coast Guard envisions an AIS system that is truly ship-to-ship, precluding the need for shore infrastructure to receive information. However, the system will also have the ability to relay vessel position information as well as add information from a shore component.

EXCHANGE AND DISPLAY OF AIS INFORMATION

Like any information system, AIS can be broken into the basic components of assembling information, communicating information, and displaying information. Users have told us that the system must provide a traffic picture in the wheelhouse so it will be available to improve the mariner's situational awareness. Basic elements of information such as ship's name, position, course, and speed would be gathered from one's own ship sensors and transmitted and displayed in the desired format (ARPA, carry aboard Laptop Electronic

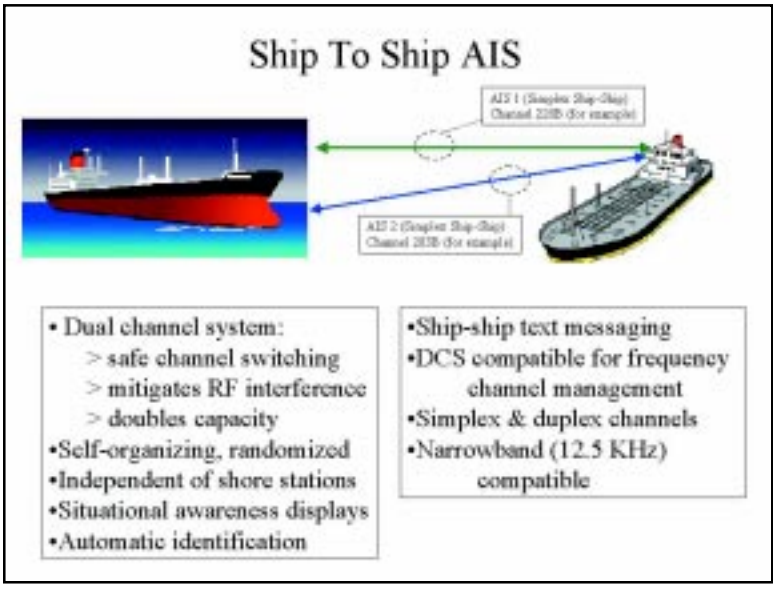


Enhanced AIS.

Charting System [ECS], or an IMO-compliant ECDIS, etc.) consistent with the needs of the user.

AIS IN THE VESSEL TRAFFIC MANAGEMENT HIERARCHY

The Coast Guard intends to incorporate AIS into a strategy of vessel traffic management (VTM) tools dealing with risk in the waterway. The strategy matches risk against a continuum of tools. The practice is to choose the lowest common denominator tool to successfully mitigate risk. The hierarchy starts with traditional navigation tools (traffic separation schemes, regulated navigation areas, aids to navigation, dredging, and Rules of the Road). Next we work up to an AIS application (ship- to-ship data exchange), an Enhanced AIS (ship-to-ship data exchange plus additional information), and finally if risk has not been addressed, we move to the interactive vessel traffic management tool—the VTS.



Basic AIS.

THE AIS TOOL

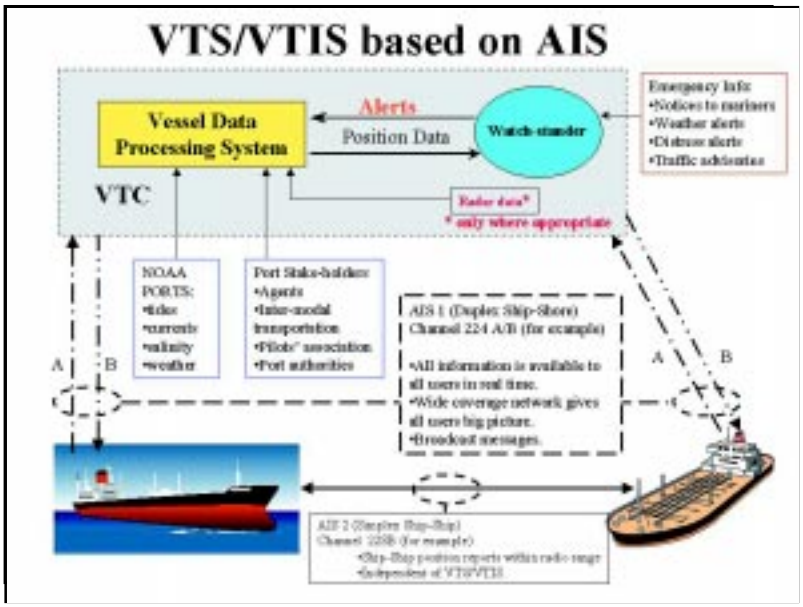
• Basic AIS: Our horizon of safety will expand greatly with the advent of AIS. AIS is the most desired technological feature, from the mariner's perspective, that was discussed at outreach discussions. The system can raise situational awareness in all areas because of the ship-to-ship reporting and can raise the safety foundation across the board.

• Enhanced AIS: Enhanced AIS builds on ship-to-ship data transfer and incorporates other data sources (weather, current data and depths, Notice to Mariners, etc.), into the information stream available to the user. This is not a full-fledged VTS as there are no traffic watchstanders present. As shown in the figure, a multi-mission watchstander (Group, Activity, District) tasked with duties such as SAR, Law Enforcement, and Aids to Navigation could put safety information into the system.

• VTS/VTIS: The Coast Guard plans to integrate AIS technology into VTS. An AIS-based VTS/VTIS will allow situational processing/awareness to take place by an independent third party. We envision an AIS-based VTS that is supported by decision-making tools which will assist the mariner in safe passage. A VTS provides another dimension to the safety equation—competent authority oversight. VTS has the ability to implement traffic directions as needed.

As previously mentioned, universal AIS can raise the safety threshold dramatically because of the coverage afforded by the ship-to-ship function. The area of benefit in the United States is estimated to be over 12,000 miles of coastline and another 25,000 miles of internal waters, without constructing a VTS. This represents a huge increase from the current 900 miles of surveillance provided by VTSs.

In a limited number of areas, the increased levels of traffic organization and shoreside assistance provided by VTS will be needed to address risk drivers not adequately addressed by other, less aggressive VTM tools.



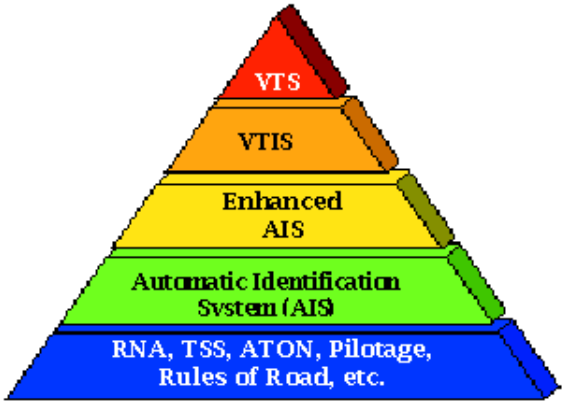
VTS/VTIS.

AIS TESTING IN THE LOWER MISSISSIPPI– VTS NEW ORLEANS

With Congressional approval, the Coast Guard is building an AIS-based VTS in New Orleans. (An AIS-based VTS will require vessel carriage of a transponder to be effective. The decision of which vessels will be required to carry an AIS transponder will be determined through the Coast Guard rulemaking process after the New Orleans test.) The Coast Guard will leverage the use of ship-to-ship transponders and the use of a limited number of radar to enhance the safety of the Lower Mississippi waterway system. Ultimately, the Coast Guard will acquire and test approximately 70 transponders on the lower Mississippi River. The area of concern covers approximately 270 miles (from 20 miles above Baton Rouge to the sea buoy) with emphasis on blind bends and narrow channel widths near Algiers Point and at the South West Pass entrance. During the test period, the Coast Guard will provide the transponders, at no cost to the mariner, as we assess the capability of the system. At the conclusion of the test period, transponders may be made available to the mariner at a low cost. The test strategy is as follows.

• First stage of testing. The Coast Guard has acquired and placed 50 transponders (which operate in the ship-to-shore mode only) aboard various types of vessels that operate on the Lower Mississippi River. The transponders vary in design from type Is—portable carry-aboard units weighing 18 lbs; type IIs—fixed units hard wired into the vessels wheelhouse; and type IIIs—fixed units that transmit a signal only and do not have an electronic chart. The purpose of this stage is to load test the Coast Guard Vessel Traffic Center to document the system's performance as we transition to an AIS-based VTS under the Ports and Waterways Safety System acquisition.

APPLYING THE VTM HIERARCHY

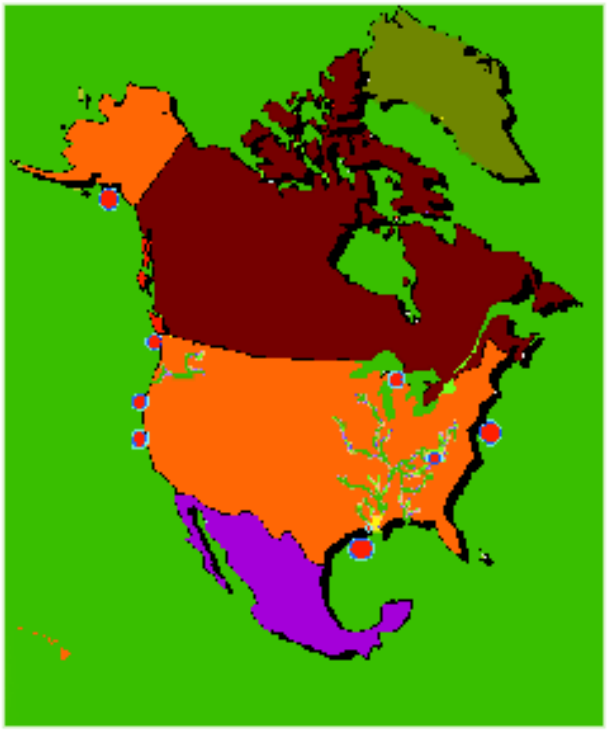


AIS Standards Status

Standard Type	Answers	Governing Body	Status	Update
Functional	What is wanted	International Maritime Organization	Approved	
Technical	How to do it	International Telecommunication Union-Radio	Approved	
Frequency				
International	How to communicate	World Radio Commission	Universal Frequencies recommended	Channels 87b and 88b selected for AIS operations.
National		FCC	Petition submitted	
Certification	Does it do it	International Electrotechnical Commission	In development	Next meeting Feb 2000. Draft document by Summer 2000

AIS/VTS COVERAGE AREA (NORTH AMERICA)

- 12,375 miles of coastal shoreline (U.S.)
- 25,000 miles of river and intracoastal shoreline
- 2,240,500,000 tons of cargo
- 182,768 import/export transits



• Second stage of testing. The Coast Guard will conduct another transponder buy in early/late fall. The purpose of this second transponder buy is to test compliance with the universal standard and interoperability between manufacturers. Testing will include both ship-to-ship and ship to shore. The original 50 ship-to-shore transponders will be "retro-fitted" to meet the ship-to-ship criteria of the second acquisition in a timeframe to be consistent with proposed mandatory carriage. This will provide approximately 70 transponders that will perform in the ship-to-ship mode and interact with the Coast Guard VTS, providing us with more data on system performance.

AIS STANDARDS

• An AIS functional performance standard was recommended by IMO Navigation Sub-Committee in July 1997. This performance standard was forwarded to the IMO Marine Safety Council and adopted in May 1998.

• A draft AIS technical specification was recommended by an International Telecommunications Union (ITU) working group in March 1998. This technical specification was approved by ITU.

• The World Radio Commission, at WRC 97, allocated two frequencies in the maritime mobile band (87B and 88B) for AIS transponder use.

AIS FREQUENCY

The USCG supports universal AIS frequency availability. We are working with the frequency licensee to make the frequencies available so the system is functional and responsive in accordance with the guidance of the World Radio Committee.

Proposed AIS Carriage: The IMO Sub-Committee on Safety of Navigation recently proposed carriage of AIS for all ships 300 gross tons and upward on international voyages and for cargo ships of 500 gross tons and upward not on international voyages. Additionally, AIS carriage is proposed for all passenger ships. The following timeline for a phased-in implementation of AIS carriage will be forwarded to the IMO Maritime Safety Committee for a final decision.

Ships constructed on or after July 1, 2002—AIS required

Ships on international voyages built before July 1, 2002:
• Passenger Ships and tankers, not later than July 1, 2003.
• Ships, other than tankers, 50,000 gross tons and upward, not later than July 1, 2004.
• Ships, other than tankers, between 10,000-50,000 gross tons, not later than July 1, 2005.
• Ships, other than tankers, between 3,000-10,000 gross tons, not later than July 1, 2006.
• Ships, other than tankers, between 300 – 3,000 gross tons, not later than July 1, 2007.
• Ships not on international voyage built before July 1, 2002, carriage not later than 1 Jul 2008.

Partnership Approach to Waterways Management—Harbor Safety Committees

By LT Gregory D. Case, Office of Policy and Planning, Waterways Management Directorate, USCG Headquarters, Washington, DC

What are Harbor Safety Committees? The term "Harbor Safety Committees" originated with local harbor safety coordinating bodies mandated by the California Oil Spill Prevention and Response Act of 1990. The term, though, has become generic for all such organizations that are alike in structure and purpose. Therefore, Harbor Safety Committees (HSCs) can be defined as local coordinating bodies whose responsibilities include recommending actions to improve the safety of a port or waterway. They are generally comprised of representatives from maritime labor and industry organizations, environmental groups, governmental agencies, and other public interest groups. There is a great amount of diversity among HSCs. Some, like those in California, are mandated by state or federal law. Some were started by port interest groups such as the Maritime Association of the Port of New York and New Jersey. Their HSC is called the Harbor Safety, Navigation & Operations Committee. Still others, such as the Port and Waterways Safety Groups of Milwaukee and Sturgeon Bay, Wisconsin, were partnerships initiated by the local Coast Guard Captain of the Port (COTP).

Where do HSCs fit into the waterways management picture? A brief background is helpful. HSCs are not a new breed of organization or something that has been invented to support a new initiative. Although not as venerable as some port institutions and organizations, HSC-like groups have existed in most major ports for a number of years and have enjoyed many successes in improving safety in their respective locations. The Coast Guard is interested in increasing its local partnerships with HSCs to expand their scope and to facilitate formation of HSCs where they do not already exist.

The Coast Guard has long recognized the importance of local committees as the key to safe, efficient, and environmentally sound operations. In the *U.S. Port and Terminal Safety Study* of September 1996, the International Association of Independent Tanker Owners (INTERTANKO) noted that port complexes, their associated waterways, and terminals are extremely diverse in infrastructure, quality control, management, procedures, and functions. Local Harbor Safety Committees are often the only forums available for facility operators and waterway and port users to address these issues. These committees have varying degrees of effectiveness and scope and do not have standard guidelines, responsibilities, representation, or organizational structure; nor is there a national coordinating mechanism to achieve consistency or synergy among the many autonomous harbor committees. The Coast Guard and INTERTANKO entered into a partnership in the fall of 1998 to address several issues including the harmonization of HSCs.

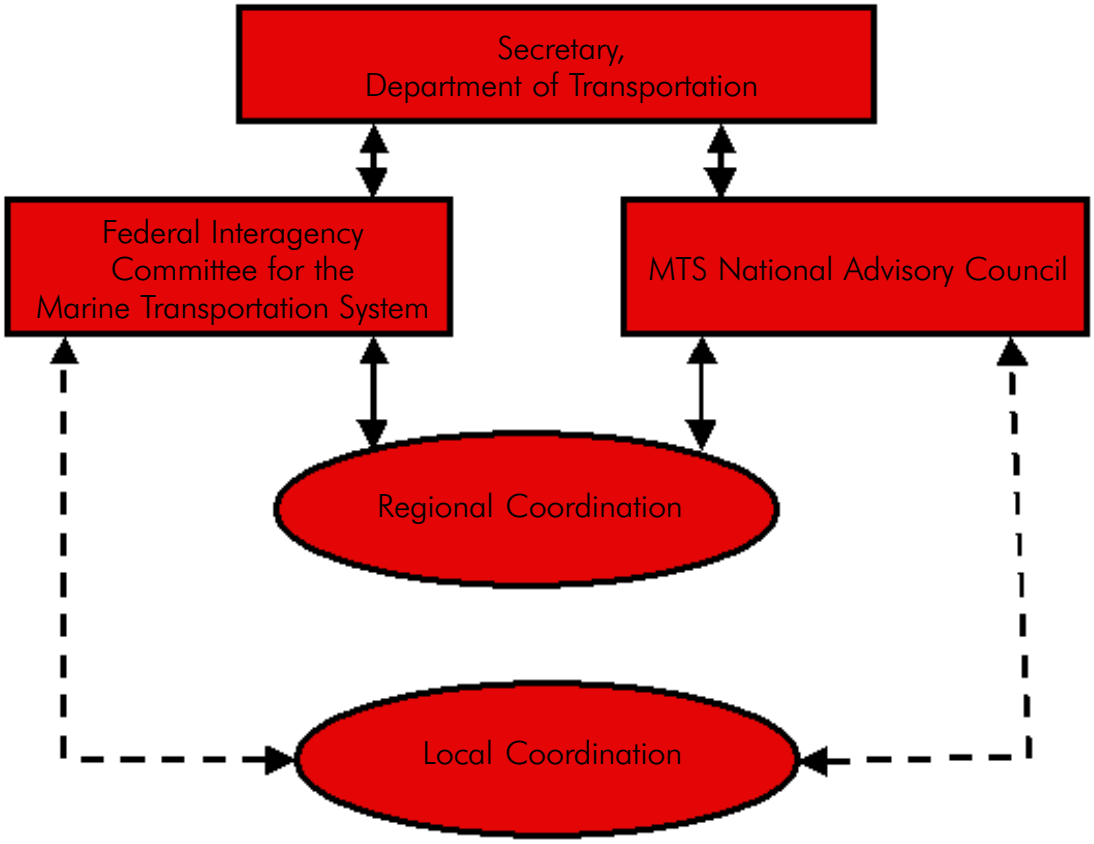


Figure 1: Marine Transportation System Coordinating Structure recommended in the MTS report. Notes: 1) Ovals contain groups with parallel functions and communication channels. 2) Dotted lines indicate alternate lines of communication. Source: adopted from "An Assessment of the U.S. Marine Transportation System: A Report to Congress," U.S. Department of Transportation, September 1999.

Coordination, or lack thereof, was also a topic of great interest at the Regional Listening Sessions on the Marine Transportation System (MTS) that led to the National Conference on the MTS in November 1998. Lack of coordination was evident not only at the national level, where agencies traditionally have not coordinated their efforts to provide common management oversight of critical issues, but also between public and private stakeholders at the state and local levels.

At the MTS National Conference, senior stakeholders agreed that:

- There is a strong need for effective local coordinating organizations.
- Successful local committees should serve as models for other areas to establish coordinating organizations or to expand the roles of existing organizations.
- There is generally no consistent mechanism for communication among local public and private sector entities.

After the National Conference, the Secretary of Transportation established the MTS Task Force mandated in the Coast Guard Authorization Act of 1998. The Task Force was to assess the adequacy of the nation's Marine Transportation System and report the results of its assessment to Congress. The Task Force Report titled, "An Assessment of the U.S. Marine Transportation System" was delivered to Congress on September 9, 1999.

A primary recommendation of the Report that evolved from the Regional Listening Sessions and the National Conference on the MTS was to establish a coordination framework. The framework recommended in the MTS report (figure 1) allows and supports the level and types of coordination necessary at the local, regional, and national levels to achieve the MTS desired state in 2020. The two key national elements are the establishment of an MTS National Advisory Council (MTSNAC) and a federal Interagency Committee for the MTS (ICMTS). The Council, comprised entirely of private-sector members, and the ICMTS will provide a structured approach for addressing national-level issues and recommendations. The Maritime Administration has been charged with organizing and chartering MTSNAC while the Coast Guard has responsibility

to create ICMTS through the expansion and re-chartering of the existing Interagency Committee on Waterways Management (ICWWM). Other key elements at the national level are the establishment, as needed, of ad hoc committees to provide expert advice to MTSNAC.

Below the national level are regional elements, which are optional, and local elements. The Report's recommendations addressed the calls for local coordination and leadership by endorsing HSCs as the standard, local mechanism in the proposed coordination framework. An example of a coordinating structure at the regional level is the recently established Great Lakes Regional Waterways Management Forum. An example of a local committee is the Harbor Safety, Navigation & Operations Committee in New York. This framework allows local committees to coordinate discussion and resolution of local issues and provides a mechanism to coordinate decisions beyond jurisdictional boundaries on issues that affect broader regional areas or are matters of national significance.

Existing HSCs will be used as national models for the establishment of HSCs in other areas. The role of HSCs is envisioned as possibly expanding beyond safety to encompass the wide range of issues that affect the MTS as a whole. Detailed recommendations from the MTS report direct HSCs to focus on specific issues dealing with safety and environmental protection, public awareness, and security. The Report recommends that HSCs approach local issues in a holistic and systematic way, using risk analysis/management to assess and address problems falling into categories such as ship-terminal interface, port development, terminal operations, vessel operation, and the human element.

Now that we know what HSCs are and their role in the MTS, it is important to explain why HSCs are necessary or vital to waterways management. The primary goal of the MTS initiative was to find out where we are and where our MTS needs to be to remain globally competitive. It was found that the MTS is stressed in many areas now and will become more so in the near future because of current and future trends and pressures. A national response is needed to address these concerns. Because ports in the U.S. are independent and involve numerous players, a coordinating structure is needed to address these problems and to enact the recommendations of the MTS report nationally. It is necessary within this coordinating structure to have some standard means or vehicle to address and communicate local concerns and issues, which is directly connected to both regional and national elements of the coordinating system. Harbor Safety Committees fill this role at the local level, which is vital to both the MTS and the Coast Guard's waterways management goals.

The Coast Guard is supporting the local coordination effort on several fronts including the development of guidance to support existing HSCs and to help start new committees where none currently exist. We have already conducted a national survey of existing HSCs and are building on that work by commissioning a study to determine certain generic characteristics that would be beneficial to all HSCs. We are also developing a web-based communication interchange for HSCs. This system will provide a forum for HSCs to communicate with each other and for sharing best practices and lessons learned. This exchange of information will help "cross pollinate" and strengthen HSCs, increasing their overall effectiveness as the foundation of the MTS coordinating structure. This system will also serve as a vehicle for HSCs to bring national level awareness to local issues.

There are already many HSC-like organizations in place and the local Coast Guard Captains of the Port (COTPs), more often than not, have some level of interaction with these groups. The Coast Guard, however, intends to step up this effort to ensure that HSCs have the support and tools necessary to fulfill their responsibilities and missions. The Coast Guard does not intend to take over or micromanage these entities, but to support and enhance them through strong local partnerships using tools such as Coast Guard-developed guidance and risk assessment and management systems like the Waterways Evaluation Tool and Port and Waterways Safety Assessments. As with any partnership arrangement, the strength and effectiveness of HSCs will in large degree depend on the initiative and cooperation of the local private and public sector stakeholders. The Coast Guard, however, is committed to making the tools and support necessary for HSC viability available to all port and waterway users and stakeholders.

Harbor Safety Committees will continue to play an important role in waterways management. They face two initial challenges that must be overcome to make them ready for that task: (1) increase their level of harmonization; and (2) enhance their effectiveness. Harmonization is addressed through the coordination structure and recommendations in the MTS report, which gives HSCs a common purpose and place in the U.S. MTS. Their effectiveness can be improved through the partnerships they form with the Coast Guard and other agencies at the local level and by the guidance and tools that the Coast Guard is developing. With enhanced support, HSCs can be powerful positive forces in enhancing the safety in our nation's ports and more importantly in advancing the entire U.S. Marine Transportation System into the next century.

Partnership Leads to more than Just Traffic Management

By LT Alan Tubb, Watch Supervisor, Vessel Traffic Service San Francisco

Vessel Traffic Service (VTS) San Francisco, commanded by CDR Danny Ellis, is located at the top of Yerba Buena Island in the heart of the San Francisco Bay region, which comprises seven port authorities (San Francisco, Oakland, Redwood City, Sacramento, Stockton, Richmond, and Benicia) and 150 miles of navigable waterways. The combined commerce of the region makes it the fourth largest commercial shipping hub in the United States. Within VTS's area of responsibility (AOR) lie sensitive environmental areas; extensive recreational boating areas and industrial development; and a large population, all of which compete for the resources and use of the limited available waterway space.

Striking a balance between advising, being kept advised, and networking with the "players" on San Francisco Bay has paid huge dividends in the development and maintenance of relationships within our core customer base. VTS San Francisco has established itself as more than a regulatory traffic management service—it is a true partner of the commercial and recreational user of the San Francisco Bay and its tributaries.

The primary mission of VTS San Francisco is to coordinate the safe and efficient transit of vessels in San Francisco Bay and its approaches and tributaries in an effort to prevent accidents and the associated loss of life and damage to property and the environment. Secondary missions include assistance to other Coast Guard units in the discharge of their missions, such as aids to navigation, search and rescue, law enforcement, maritime defense zone operations, carrying Captain-of-the-Port responsibilities for anchorage administration, Port State Control, ocean dumping, and the movement of certain dangerous cargoes within the VTS AOR. VTS San Francisco accomplishes this with a crew of 38, including 16 active duty, 5 reserve members, 15 civilians, and two on-site computer maintenance contractors.

In the execution of its primary mission, VTS aims to spend at least ninety percent of its effort monitoring and informing on vessel traffic. VTS San Francisco works hard to act as "a member of the bridge team," versus a strictly regulatory entity. In an effort to provide this type of service, VTS San Francisco has developed an aggressive partnership program that extends well beyond the traditional traffic service users of San Francisco Bay. The following is a description of the key partnerships fostered by VTS.

The Marine Exchange of San Francisco Bay

The Marine Exchange of San Francisco Bay is a nonprofit maritime information clearinghouse that provides scheduling services to ship and tug companies throughout the San Francisco Bay area. Also managed by the Marine Exchange is the San Francisco Bay Harbor Safety Committee. To provide industry access to VTS as well as to provide VTS input on proposals affecting commercial waterborne transportation on the bay, VTS San Francisco participates, as a non-voting member, on both the Prevention Through People and Joint Planning Partnership subcommittees of the Harbor Safety Committee.

San Francisco Bar Pilots Association

As a primary user of VTS, the Bar Pilots are a major stakeholder in the development and

implementation of VTS policy. A valuable partner with VTS since its inception in 1972, the Bar Pilots recently joined VTS in implementing the VTS-Pilot Information Committee, or VPIC, which meets on a monthly basis, allowing the VTS and the pilots to discuss issues and resolve conflicts that affect them in a timely manner. The Pilots Association has also implemented a pilot visit program, in which a Pilot comes to VTS (one each week) to observe operators in the performance of their duties, as well as to share insight and local knowledge with operators. VTS reciprocates this effort through its vessel ride program, in which VTS operators ride with pilots to observe them as they operate and make use of the VTS service. This dynamic relationship significantly adds to the quality of service provided by VTS San Francisco to all users throughout the bay, not just the Bar Pilots.

Ferry companies

In a similar relationship as that with the Pilots Association, VTS San Francisco meets quarterly with operations personnel from the major ferry companies operating on the San Francisco Bay in order to discuss issues and concerns. These ferry companies encourage their operators to visit the VTS operations center in an effort to further their understanding of our service. VTS San Francisco has recently established an operator ride program, similar to the one with the Bar Pilots, to increase our understanding of the specific needs of the ferry boat operators.

Passive users

Scattered throughout the VTS San Francisco AOR are over 250 yacht clubs and marinas, as well as seven commercial fishing vessel hubs. Although not required by law to participate in the VTS, these vessels account for our largest number of "passive" users. Throughout the summer months, VTS San Francisco dispatches personnel to yacht clubs to describe our service, explain Rule 9 of the Inland Rules of the Road, and attempt to proactively deconflict commercial and recreational close-quarters situations. We also provide representatives to the annual herring fishery season planning meeting, as well as walking the docks at fishing vessel hubs, to improve users' understanding of our service. Recognition of the fishing fleet as a target user gained significance in 1986 when the tanker *Golden Gate* struck the fishing vessel *Jack Junior*, killing 3 fishermen just south of Point Reyes in what is now the offshore traffic management sector.

The Union Pacific Railroad Bridge/CALTRANS

A rather unique partner of VTS San Francisco (and one not normally associated with shipping), the Union Pacific Railroad operates a lift bridge connecting Martinez and Benicia in the Suisun Bay. There are a significant number of vessels transiting the UPRR Bridge en route to Martinez, Stockton, and Sacramento requiring a lift. Because of this, VTS San Francisco established a working group including VTS San Francisco, the Bar Pilots, bridge operators, and local facility operators in an effort to improve understanding of each participant's requirements for a safe and timely transit of shipping traffic under the bridge.

Another unique partner of VTS San Francisco's is the California Department of Transportation (CALTRANS). CALTRANS is currently in the process of conducting a seismic retrofit of all six bridges within the VTS San Francisco AOR. With a poor understanding of San Francisco vessel traffic movements, compounded by the use of out-of-area contractors, the potential for problems was high. VTS San Francisco invited CALTRANS and its contractors to VTS and conducted briefings on standard operating procedures within the bay in an effort to greatly reduce the potential for conflicts.

People's Republic of China

In what may be our boldest new partnership, VTS San Francisco has developed a relationship with the vessel traffic service in Shanghai, People's Republic of China. This effort has allowed two very similar organizations from two very different countries to share ideas on vessel traffic management. This partnership has also opened the door for the Pacific Area Commander to begin discussions with representatives of the People's Republic of China on other shared maritime interests within the Pacific Ocean.

Partnership in action: Y2K

Although VTS San Francisco is operating on systems that are certified as Year 2000 compliant, many of our primary customers are not so lucky. Many of VTS's highest volume customers—the ferry companies—are small companies with limited resources. Through an aggressive outreach program, VTS San Francisco engaged these customers in a dialogue about the problem and will act as an information conduit as the next millennium approaches. VTS is assisting these small companies with their strategies and contingency plans, with hopes that this partnership will serve as a model for dealing with other pressing issues in the future.

Vessel Traffic Service San Francisco has established itself as more than a regulatory traffic management service. It is a true partner of the commercial and recreational user of the San Francisco Bay and its tributaries.

Managing the Waterways in the Ninth Coast Guard District

By RADM James D. Hull, Commander, Ninth Coast Guard District, CAPT Randolph C. Helland, Chief, Ninth Coast Guard District Marine Safety Division, and CDR Patrick G. Gerrity, Chief, Ninth Coast Guard District Marine Safety and Policy Branch, Cleveland, OH

Geo-political overview

The Great Lakes are internal territorial waters of the United States and Canada, over which the eight U.S. Great Lakes states and two Canadian provinces exercise territorial jurisdiction. The Great Lakes are nearly landlocked, with a long, shallow route to the sea. The common international border is over two thousand miles in length and passes through a number of narrow connecting rivers, including the St. Lawrence, the Detroit/St. Clair System, and the St. Mary's River. There are no exclusively federal waters on the lakes, and the U.S. Great Lakes states have a strong, long-standing sense of state ownership over their Great Lakes resources. Due to the geography of the Great Lakes, a high degree of international and interstate cooperation is absolutely necessary to manage this waterway. The legal and political regime of the Great Lakes commercial system is just as unique as the underlying geographical and economic aspects of the Lakes themselves.

The following are just some of the unique characteristics of the Great Lakes:

- The region is a binational system with full sovereignty over internal waters exercised by U.S. and Canadian federal authorities.
- There are unique regional federal authorities in the form of the two Seaway authorities (one U.S. and one Canadian) and the International Joint Commission—a binational group established to monitor the use and environmental quality of the Great Lakes.
- The United States controls only 6 of the 20 locks on the Great Lakes/St. Lawrence Seaway system: Canada operates the 14 other locks.
- There are particularly strong state governments represented by the Congressionally chartered Great Lakes Commission.
- There is active involvement in regional issues by the governments of the two most populous Canadian provinces, Ontario and Quebec.
- The active and highly professional marine industry is represented in the form of the U.S. Lake Carriers' Association, the Canadian Shipowners Association, the Shipping Federation of Canada, the U.S. Great Lakes Shipping Association, and the Great Lakes Towing Company.
- There is increasing involvement in economic development by dynamic Port Authorities at Duluth, Milwaukee, Chicago, Burns Harbor, Detroit, Toledo, Cleveland, and Buffalo.
- The citizens of the Great Lakes region are well educated, politically active, and extremely sensitive about any impairment of environmental quality or recreational use on the Great Lakes.

The Great Lakes Marine Transportation System

The Great Lakes Marine Transportation System (MTS) provides a clear example of the importance of maritime infrastructure and presents many of the pressing issues prompting the Secretary of Transportation's Marine Transportation System Initiative. Both the domestic "laker" fleets of the U.S. and Canada and the third-party foreign "salties," which connect major internal cities of the U.S. to the world through the St. Lawrence Seaway, are critical to maintaining the competitiveness of the

U.S. industrial heartland. The Great Lakes MTS is a vital link for moving goods between the heartland of North America and the international markets. Key Great Lakes system attributes and issues include:

• The Great Lakes MTS carries nearly 200 million net tons of domestic and foreign cargo per year and is home to 14 of the nation's top 100 ports in terms of tonnage moved.

• Passenger vessels from Europe are once again visiting Great Lakes ports, bringing in hundreds of passengers to the region's cities. In fact, one company's vessel is completely booked for the next three years, and they anticipate building more ships for the Great Lakes.

• Shipping contributes greatly to the economies of all Great Lakes states and provinces, providing billions of dollars worth of cargo and millions of dollars of tax revenue. Shipping on the Great Lakes system directly and indirectly supports hundreds of thousands of jobs.

• The Great Lakes serves the owners of an estimated 2.3 million registered U.S. recreational boats that contribute several billion dollars to the region annually.

• During the 1998 navigation season, 52 million metric tons of bulk cargo, mostly grain, coal, and steel passed through the St. Lawrence seaway, representing a cargo value of $7.5 billion.

• Shipping on the Great Lakes is not significantly increasing compared to the 20% to 30% growth rate experienced by the U.S. coastal ports and on the Ohio and Mississippi river systems.

Icebreakers are needed in some areas to clear lanes for commercial ships during winter.

• There is very little container traffic on the Great Lakes. Most commercial cargo on the Great Lakes is carried in bulk.

• Most regions of the Great Lakes MTS can only support a 10-month navigation season. Most other waterway regions in the nation support year-round navigation similar to rail and truck transportation systems.

• Ship sizes are restricted to a beam of 78 feet, a draft of 26.25 feet and a length of 740 feet by the St. Lawrence Seaway. This means about 60% of the world fleet of commercial oceangoing vessels are too large for the seaway. The worldwide trend is for even larger ships.

• Ship sizes through the locks at Sault Ste. Marie are restricted to a beam of 105 feet, a draft of 27 feet and a length of 1000 feet.

The challenges ahead

With more than 100,000 square miles of navigable water and 10,579 miles of shoreline, the Great Lakes anchor an important and growing marine and recreational industry. While the Great Lakes MTS is relatively strong, there are challenges ahead that must be overcome to ensure that it continues to provide an economically valuable and environmentally safe means of transportation into the next century. Some of the challenges include:

• *No regional waterways management vision or strategy.* There is no unified vision of how our regional Great Lakes MTS should optimally be used to facilitate commerce. Without a clear vision we may perpetuate a system that is inefficient and unable to take advantage of opportunities for growth.

• *System congestion*. In the next 20 years, the volume of domestic and international trade is expected to double nationally and recreational boating is expected to grow by 65%. This will undoubtedly have an impact on the Great Lakes.

• *Aging physical MTS infrastructure*. As the Great Lakes infrastructure ages, its economic effectiveness and competitiveness is reduced. The St. Lawrence Seaway locks are 40 years old, the newest lock at Sault Ste. Marie is already 31 years old, and the Coast Guard ice breaker *Mackinaw* is 55 years old. If not modernized, the Great Lakes may not be able to accomodate existing trade, let alone compete successfully for the increase in trade forecast for the rest of the country.

• *Increased competition for waterfront land*. Many cities may develop their waterfronts without addressing traditional maritime and industrial uses; rather they will focus on recreational, tourist, and residential related uses.

• *Poor intermodal connections*. Land-side access is a major challenge that most U.S. ports are facing. Con-

One of the more pressing issues on the Great Lakes is the competing interests between commercial and recreational users.

nections between the transportation modes are often the weakest link in a region's transportation system. Many ports are located in large metropolitan areas where truck and rail traffic compete with commuters on crowded highways. Inefficiencies at any point in the system can disrupt the total system.

A regional solution

Many of the challenges are being examined by a variety of partnerships at the national, regional, state, province, and local level, but the efforts are not coordinated as well as they could be. To address the most pressing MTS issues in the Great Lakes region, the Great Lakes Regional Waterways Management Forum was created in March. The Forum's purpose is to identify and resolve waterways management issues that involve the Great Lakes region. This body specifically reviews issues that cross multiple jurisdictional zones and involve international issues. The Forum focuses on developing operational solutions that improve the use and effectiveness of the Great Lakes for all. The Forum does not address operational issues that are best resolved at the port level.

The Forum is chaired by the Commander of the Ninth Coast Guard District and the Commander of the Army Corps of Engineers Great Lakes and Ohio River Division. It consists of 26 U.S. and Canadian senior members of government and the private sector who represent various Great Lakes MTS interests. The Forum meets publicly at least twice a year to assess the Great Lakes region, prioritize areas of concern, and identify issues for resolution. The Forum is a first in the nation for two reasons: (1) it is the first waterways management group formed to address an entire regional waterway, and (2) it is the first group formed to address international waterway issues.

To accomplish the work necessary to resolve a regional issue, the Forum has created several subcommittees. Forum members are responsible for identifying subcommittee members from their organizations and ensuring their members commit the necessary time and effort to resolve the identified waterways problem. Forum subcommittees must have at least one person from the Forum as the subcommittee chair. Solutions to waterways problems developed by the Great Lakes Regional Waterways Management Forum are reported at the annual Great Lakes Marine Community Day and at other pertinent forums. Currently, the Forum is working to improve intra-governmental and industry communication, investigating technologies such as Automatic Identification System (AIS) to improve navigation safety and efficiency, and identifying approaches for the resolution of waterway conflicts.

The Forum faces many challenges in the upcoming months and years. The key questions the forum will be considering are:

- What should our regional vision be for the future of the Great Lakes/St. Lawrence Seaway Marine Transportation System?
- What infrastructure investments are needed to ensure that the Great Lakes Marine Transportation System remains viable during the next century?
- What is the proper role of each level of government and industry in reaching these ends?
- What is the proper balance between recreational and commercial usage of the Great Lakes Marine Transportation System?
- Can we ensure that the environmental integrity of the Great Lakes remains a top priority for years to come?

While these questions have a Great Lakes focus, they easily apply to other areas of our national Marine Transportation System.

Conclusion

The Great Lakes is one of the most congested waterways in the world, with significant commercial and recreational traffic in close proximity. It is also one of the most highly sensitive ecosystems in the world. As a unique binational federal, state, and provincial regime, nothing good can be accomplished without a large degree of partnership and interagency cooperation. Given this, we in the Ninth Coast Guard District believe the Great Lakes Regional Waterways Management Forum is the type of partnership needed to ensure that one of our nation's most important Marine Transportation Systems remains viable and competitive into the next century.

A Cooperative Approach to Waterways Management—Rank by Risk, Target by Rank (R2TAR)

By LCDR Brian Peter and LT Eileen Nally, USCG, MSO Juneau, Alaska

At Marine Safety Office (MSO) Juneau, Alaska, our mission as directed by program managers at Coast Guard Headquarters and the Seventeenth Coast Guard District, is to protect the public, environment, and U.S. economic interest through the prevention and mitigation of marine incidents. We approach our mission with strong emphasis on three operational themes: Risk Management, Prevention Through People, and Quality Partnerships. Our unit mission statement is "Managing Today's Risks to Prevent Tomorrow's Casualties."

Twenty-five active duty members, three civilians, and six integrated reservists pursue the goals and missions throughout an area of operation (AOR) roughly the size of Florida. This area is carved up by fjords into 13,000 miles of shoreline. Two Marine Safety Detachments (MSDs), Ketchikan and Sitka, are required to adequately cover the resource rich, often hostile and unforgiving marine environment of Southeast Alaska. The most concentrated and significant "stand alone" effort by the MSO in 1998 and 1999 was the development of a comprehensive, objective risk analysis of our waterways, along with a management scheme for addressing those risks, with the limited number of personnel available. The "Rank-by-Risk, Target-by-Rank" process, deployed through the Southeast Alaska Field Commander's Council, has received Coast Guard-wide attention.

Southeast Alaska (SEAK) is a region with distinct geography, economy, and history. Known as the "panhandle," it stretches roughly 550 miles in a generally southeast to northwest direction. It has a history rich in fishing, mining, logging, and tourism. By the United Nations definition, it would be considered a developing country. It exports mainly raw materials and all manufactured goods are imported. There is a large tourist trade and limited infrastructure. With no connective road system, there is a heavy reliance upon the waterways as the primary transportation link. The Inside Passage is world famous for its scenery and is a Mecca for cruise ships during the summer months. The waterways are stressed with increasing tourism and economic growth. As a result, Southeast Alaskans rely heavily on government waterway managers to effectively balance the multiple demands being placed upon its waterways while protecting its pristine environment.

Because many of the waterways and ports in Southeast Alaska are developing, the policies applicable to developed waterways may not work. In the past, waterway managers established priorities, designed policies or regulations, and allocated resources without reference to a systematic model or matrix designed to measure the risk and the risk perceptions of the users. This was done without consulting other waterway managers or stakeholders. This led to inefficiency among various government agencies tasked with waterways management. This method was considered adequate before the public became concerned or preoccupied with government waste, environmental protection, and

economic development. However, in an era of budget downsizing, developing new technologies, and programs vying for limited resources, it is imperative that waterway managers study their waterways and develop partnerships with other waterway managers and stakeholders. Such initiatives further demonstrate a commitment to the maritime community and a holistic view to waterway management.

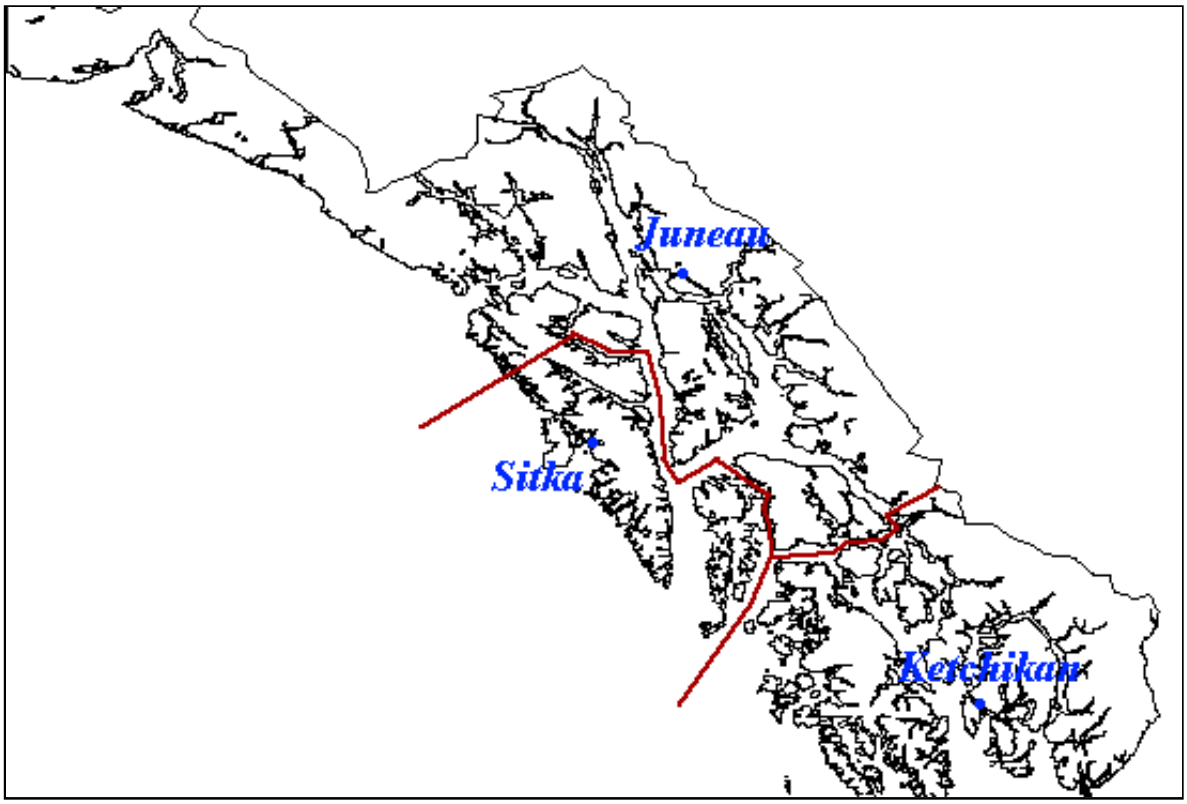
Within Southeast Alaska, a comprehensive waterway study was conducted to develop a systematic process to measure the perceived risks of Southeast Alaska waterways. This study ranked 33 waterways within Southeast Alaska in terms of waterway significance, environmental concerns, characteristics, and navigation difficulties. The results provided the basis for ranking and addressing a number of waterway issues by a newly created cooperative group of waterway managers. This group became known as the Southeast Alaska Field Commanders Council on Waterways Management. Members within this cooperative group included representatives from Coast Guard Marine Safety, Aids to Navigation, National Oceanic and Atmospheric Administration (NOAA), Army Corps of Engineers (USACE) and Coast Guard buoytender skippers assigned to the SEAK waterways. The waterway prioritization project and initiatives by the Southeast Alaska Field Commanders Council was called R2TAR, or Rank by Risk, Target by Rank, by the Captain of the Port, Southeast Alaska at that time, CDR W. David Eley, USCG (retired).

Both the risk ranking and the targeting of projects developed along with the influence of the Council. The charter tasks the Council to:

- Identify factors that are associated with maritime casualties.
- Develop and execute activities that measurably reduce those risk factors.
- Effectively communicate concerns, activities and progress to waterway users and the public at large.
- Identify improvements to the waterway that can maximize its potential for commerce and recreation without compromising public safety or environmental safeguards.

Council membership is limited to the empowered representative of the federal agencies directly involved in the "hands on" management of the waterway. This means the Captain of the Port or the Commanding Officer of a buoytender is at the table rather than a staff member. Much of the Council's success can be attributed to its relative small size, uniform dimension, and concentration of decision

Captain of the Port, Southeast Alaska Zone stretches from the Dixon Entrance to the south to Icy Cape in the North. The zone is divided into three geographic areas. Southern Southeast Alaska is handled by Marine Safety Detachment Ketchikan. Marine Safety Detachment Sitka is responsible for Baranof Island and West Chatham Strait. Marine Safety Office Juneau, the parent unit, is responsible for the rest of Southeast.



makers. Consensus is easy to achieve and the targeting of resources to mitigate the highest risks has been easy to accomplish. The Council leverages input on difficult issues by utilizing or promoting specific working groups to tackle specific problems. Recommendations from these working groups, which may have Council members as observers, are taken to the Council for final action. Notable successes have been the publication of the Southeast Alaska Voluntary Waterway Guide, publication of the Tongass Narrows Voluntary Waterway User Guide and a regulatory change for vessel operation in Tongass Narrows. To achieve these results, a method of managing the risks had to be developed. The risk-ranking study became the first priority of the Council.

The study was conducted by LT Eileen Nally of Marine Safety Office Juneau, as part of her graduate capstone project for her Masters degree in Public Administration. The study assigned a numerical value to each Southeast Alaska waterway using a matrix that incorporated known values and perceptions from various federal, state, and local organizations within Southeast Alaska. Activities considered in the development of this matrix included: characteristics of vessels using the waterway; number of casualties; amount of cargo transported; waterway properties; number of facilities; military significance; and environmental conditions. Additional activities specific to Southeast Alaska included: economic prosperity; protection of critical habitats and endangered species; and preservation of archeological or cultural sites. Waterway

The USCGC Woodrush sails in Tracy Arm, Alaska. Buoytender Skippers bring "hands on" experience to waterway management.

Overall Waterways Ranking

Name	Significance	Environmental	Navigation	Summary
Tongass Narrows	15	11	36	62
Wrangell Narrows	13	11	36	60
Sitka Sound	14	13	26	53
Snow Pass	7	11	34	52
Peril Strait	8	8	35	51
Gulf Esquibel/Craig/Klawock	12	10	28	50
Hawk Inlet	9	8	31	48
Sukkwan Strait/Cordova	9	9	29	47
Gastineau Channel	12	12	23	47
Icy Strait/Cross Sound/Glacier Bay	12	13	22	47
Stephens Passage	11	14	22	47
Keku Strait/Kake	11	7	28	46
El Capitan/Karheen Passage	9	5	31	45
Revilligigero Channel	14	9	22	45
Lynn Canal	10	13	21	44
Sumner Strait	9	10	24	43
Clarence Strait	13	10	20	43
Chatham Strait	11	12	20	43
Dall Island	4	6	29	39
Nichols Pass/Felice Strait	10	5	24	39
Thorne Bay	6	6	26	38
Behm Canal	9	9	20	38
Stikine Strait/Wrangell	6	6	25	37
Chichagof Island West	8	5	23	36
Blake Channel/E. Passage	3	5	27	35
Portland Canal/Inlet	6	7	22	35
S. W. Baranof Island	6	4	23	33
Tenakee Inlet	6	6	21	33
Frederick Sound	7	9	17	33
Dry Strait/Stikine River	3	6	23	32
Ernest Sound/Zimovia Strait	5	5	22	32
Yakutat/Icy Bay	7	5	20	32
Duncan Canal	3	5	22	30

The *M/V Wilderness Explorer* ran aground in Glacier Bay, Alaska. Through the R2TAR process, the SEAK Field Commanders Council was able to identify charting priorities and make recommendations to NOAA for smaller scale charts of areas being visited by eco tourism vessels. This will help prevent accidents like this in future.

characteristics and navigation attributes included: visibility constraints; current and sea state; channel characteristics; aids to navigation; vessel traffic volume and patterns; communication constraints; traffic restrictions; and weather. The study included 505 surveys submitted by 107 waterway users. Results were accepted by the Council in December of 1997 and March of 1998.

The 33 waterways were studied using waterway boundaries previously established by the Coast Guard Waterways Analysis Management System (WAMS). As a result of the study, each waterway within Southeast Alaska received an overall score depicting its priority or risk in terms of waterway significance, environment considerations, waterway characteristics, and navigation. This waterway study was particularity valuable in prioritizing WAMS and other waterway-based criteria. These included justifying round-trip requirements for federal pilotage and prioritizing NOAA hydrographic survey projects.

Members of the Southeast Alaska Field Commanders Council on Waterways Management specifically addressed the need to revise the Coast Guard WAMS as a direct result of recommendations made during the waterway prioritization study. Presently WAMS appears to only meet a regulatory requirement, and results are not normally shared with the maritime public. They are conducted by one of the Coast Guard's busiest resources—buoytenders. Another concern is that many Marine Safety Offices (Captains of the Port) are not active participants in the WAMS process, despite their significant role in waterways management. The Council's proposal included developing a waterway analysis handbook to replace the present WAMS. This handbook would be co-authored through a cooperative effort of the Council. It would contain information on waterway users, USACE projects, NOAA hydrographic surveys, biological use, archaeological/cultural significance, vessel traffic patterns, float plane flight patterns, shoreside facilities, tourism trend analysis, oil spill/hazmat discharges, casualty data, communication constraints, regulated navigation areas, federal and state pilotage requirements, recreation usage, and aids to navigation. It is envisioned that this handbook would be posted on a Web site for public access and comment regarding ongoing waterway issues.

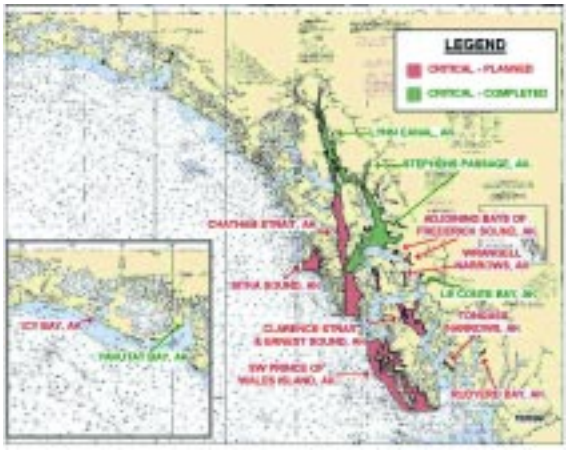
Commandant (G-OPN) recently approved the R2TAR initiative as a pilot program, thus allowing the delay of scheduled WAMS within Southeast Alaska. It is envisioned that the data found within the new handbook would be collected for a number of years and presented as an expression of a future trend, or a multiplying variable could be developed that would carry this information forward via trend analysis. Waterway managers could then make resource allocation decisions based upon future predictions. The first chapter, Tongass Narrows (the number-one-ranked waterway) is in its final review stage with a user guide already published and distributed to the public.

R2TAR was incepted and developed to address specific Southeast Alaska waterways issues from a cooperative approach among various waterway managers and users. Council members continue to meet quarterly, share information, and discuss the status of various waterway improvement projects. Many ongoing projects are the result of the initial waterway prioritization study and numerous cooperatives with other waterway stakeholders. With the pilot program approved by Headquarters, the Southeast Alaska Field Commander Council can now revise WAMS to be a more comprehensive document compiled and shared by all Southeast Alaska waterway managers and users. Other Marine Safety Offices and District Aids to Navigation Offices are now looking to R2TAR and the cooperative efforts it fosters for possible application within their zones and districts.

Holistic Approach to Waterways Management and Safety of Navigation

Problem

Safe management of thousands of miles of restricted waterways amidst the most biologically diverse and sensitive marine environment in North America for commerce and recreation.



Approach

Leverage Coast Guard resources to assess waterway performance, identify areas at risk, and allocate scarce resources to mitigate those risks in Southeast Alaska.

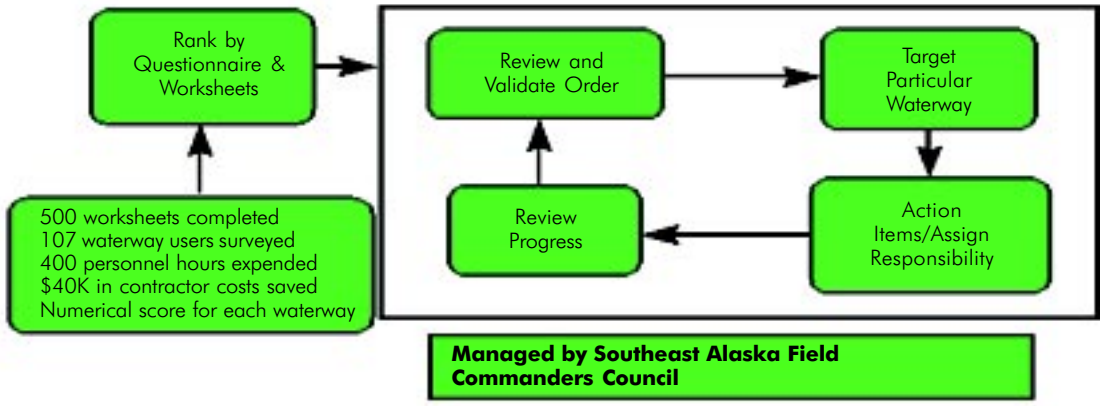
Charter the Southeast Alaska Field Commander Council on waterways management, members to include unit commanders from MSO Juneau; MSDs Ketchikan and Sitka; cutters *Woodrush*, *Planetree*, *Elderberry*, *Sweetbrier*; personnel from D17 waterways management branch; and managers from NOAA and USACE.

Quantitatively rank by risk the 33 waterways of Southeast Alaska. Target the waterways most at risk for action.

Deployment:

R2TAR

Rank by Risk, Target by Rank



Results as of December 1999

- Comprehensive Guidelines to address port congestion in Ketchikan, AK on Tongass Narrows—Operation Tame the Tongass implemented, including completion of regulatory change to address input from stakeholders (Tame the Tongass working group).
- Remote deep draft port for large bulk ore carriers opened with updated charts and aids to navigation.
- Quick objective decision regarding pilotage requirements for a new RO-RO passenger ferry destination in Yakutat Bay.
- Project to overhaul the National Waterways Analysis Management System (WAMS)
- Survey and charting priorities detailed to update navigation charts in popular remote destinations in conjunction with the Small Vessel Safety Task Force.

Waterways Management Research & Development

By Ric Walker, Senior Scientist for Short Range Aids to Navigation and Waterways Management, Aid Mix Project Manager, Coast Guard R&D Center, Groton, Connecticut

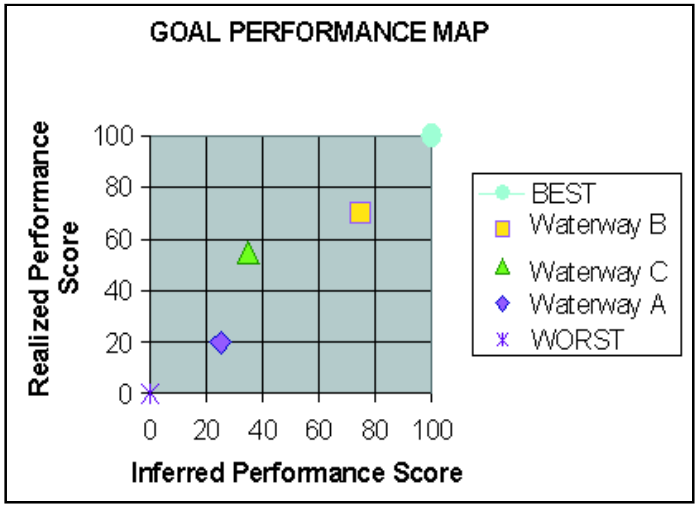
The recent Department of Transportation Marine Transportation System (MTS)—waterways, ports, and their intermodal connections—initiative has highlighted the need for a safe, efficient, and environmentally sound waterway system. The Coast Guard Research and Development Center (R&D Center) is actively engaged in a number of research projects aimed at improving the Coast Guard's ability to manage the nation's waterways. Current effort includes research and development of advanced navigation information technology and decision support tools. In addition, there are several projects in the area of risk analysis, which were described in the July-September issue of *Proceedings*.

The R&D Center is in the process of identifying a number of priority investment areas to better align the research program with critical Coast Guard missions, and to assist in closing performance gaps in these areas. Waterways management is likely to have a significant role well into the future. There are two key concepts for Waterways Management (WWM) that drive supporting research: (1) to manage waterways effectively, we must consider all aspects of the waterways, ports, and their intermodal connectors; and (2) our management efforts must be proactive rather than reactive. A number of research projects supporting waterways management are described in this article.

Waterways Evaluation Tool

The Waterways Evaluation Tool (WET) is one product being developed for a proposed Waterways Management Decision Support Toolkit (WWM DST). WET is a performance measurement tool that can baseline and monitor a waterway's status with respect to three Coast Guard (CG) strategic goals: Mobility, Safety, and the Protection of Natural Resources. In a general sense the purpose of WET is to survey the "health" of a waterway and correlate the impact of CG operations and management on maintaining or improving the waterway's well being. The scope of a WET assessment extends beyond just CG influences and also considers aspects of the waterway controlled by other federal and state agencies. As an example, it is important to know about channel constraints due to shoaling regardless of the fact that the Coast Guard is not responsible for dredging. With this capability WET will provide waterways managers with the most complete evaluation possible for their area of responsibility.

Figure 1. Potential WET output depicting performance of three similar waterways to hypothetical best and worst possibilities.



WET employs two proven practices of decision theory: value trees and the analytical hierarchy process (AHP). Value trees are used to identify, decompose and model the attributes that comprise and act on a waterway system. AHP is used to determine the relative importance of the components and to determine the intangible nature of their inter-relationships with respect to CG strategic goals. WET utilizes two value trees for each goal: a "realized risks" tree and an "inferred risks" tree. Realized risks are outcomes experienced on the waterway that we can directly measure. One example is spilled oil. Inferred risks are variables that we know impact the waterway system, but lacking complete knowledge of the data and its distribution, we can only suggest in what way. One example of an inferred risk driver is the flag state of a vessel.

WET is targeted for internal CG use by joint marine safety and operational working groups typified by waterways management offices found in CG Activities. It is expected to be a benchmark and reporting tool that will support resource allocation decisions. WET will be able to compare ports within categories sharing similar attributes (Figure 1). A decision whether to fund and deploy the WWM DST (and WET) will be made at a review meeting tentatively scheduled for June 2000. The Office of Vessel Traffic Management (G-MWV) is sponsoring this effort to help meet a business goal of reducing vessel groundings, allisions, and collisions.

Augmented-Reality Aids to Navigation System

The Augmented-Reality Aids to Navigation System (AR AtoN) project is researching the technical feasibility of providing mariners with virtual representations of aids to navigation. Conceptually, such a system would enable mariners to perceive objects as though they were located in their own physical environment. A simple conceptual drawing of the AR system is shown (figure 2). The objects would be distributed over the Internet to wireless, wearable computing devices. Augmented-reality eyewear such as glasses, monoculars or binoculars would complete the system. The eyewear would project an image of the object over the user's view of the world. Sensor fusion and software algorithms will accomplish registration of the image relative to the user's field of vision and the target point in the environment. The mariner will remain at all times in the "real" world, hence the name augmented reality instead of virtual reality, which puts people in a computer-generated world.

The impact of an AR AtoN system would be far ranging, with potential contributions to Coast Guard strategic goals of mobility and safety. The system could offer opportunities to complement, enhance, or replace our existing infrastructure. AR AtoN would also bring with it a new type of computer interface. With wearable computers the use paradigm indicates operators are doing something else besides interacting with the computer. One example might be navigating a vessel. The wearable computer would be there in a support role and would need information from the wearer's environment to access and display content in support of the mariner's situational awareness. This new process is sometimes referred to as ubiquitous computing. Ubiquitous computing is roughly the opposite of virtual reality. Where virtual reality puts people inside a computer-generated world, ubiquitous computing forces the computer to live out in the world with people. Several emerging (and merging) technologies—satellite positioning and communications systems, wireless and mobile computing, Internet and Internet information standards, and augmented/virtual reality hardware and software—are timely to this effort.

The Coast Guard Research and Development Center is kicking-off its AR research with a small business innovative research (SBIR) Phase I contract. The contract runs through March 2000 and provides a feasibility assessment of AR AtoN on which we can base future efforts.

Vessel traffic management research in San Francisco Bay

During the next decade, large vessels will identify themselves by flying a new electronic "flag" called the Automatic Identification System (AIS). This new technology will automatically identify a vessel and broadcast important navigation information such as vessel size, type, location, speed, and course. This information will be provided at a rate ranging from five to thirty times each minute, depending on vessel speed and turn rate. AIS will also receive information from other units and transfer it to shipboard display systems. The system will be able to handle at least 2000 reports per minute.

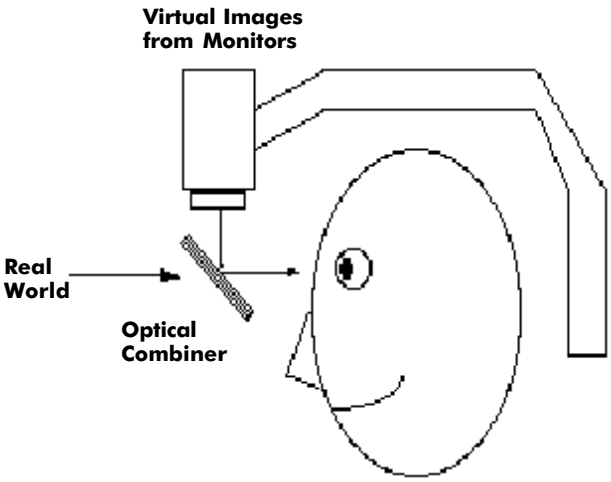


Figure 2. Schematic drawing of an augmented reality system's user interface.

AIS operation could create a virtual flood of information. Will the flood of information be useable? How will it impact the mariner? How will it be used? Will there be benefits to the Coast Guard and will it impact our future responsibilities? Investigation of the answers to these and other questions is the goal of ongoing research being done by the Coast Guard R&D Center.

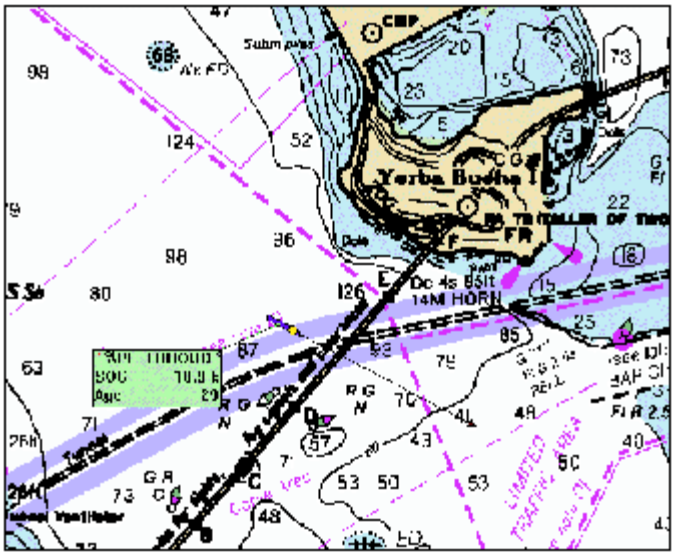
Mariners have expressed a general interest in getting better access to information, but without real experience with AIS, it was difficult for them to provide input on system requirements or discuss ultimate benefits. We needed to create opportunities for the operators to gain experience with AIS to get criti-

Figure 3. Prototype augmented reality eyewear employing miniature projector.

cal feedback on this technology. In response to this need, we created a "virtual laboratory" in the San Francisco Bay area. This virtual laboratory was designed to deliver real-time information to operators on their vessels during normal operations. The information consists of such things as the locations and movements of other vessels, water depths and currents, wind direction and speed, and the intentions of other vessels. An important part of the system design is its ability to deliver the information directly to a vessel's bridge, which requires wireless access to the information flow. At the time of the initial design, AIS technology was not available and a temporary substitute was used—a wireless Internet service provider (WISP) called Ricochet©. One drawback of using a WISP is the resulting dependence upon a shore-based infrastructure. AIS is ultimately intended to support direct vessel-to-vessel information exchange without the need for a shore infrastructure.

This system design relies on a client-server configuration. Information is provided to the server from a number of sources, such as participating vessels, National Data Buoy Center (NDBC) and National Oceanic and Atmospheric Administration (NOAA) environmental sensors, or from the San Francisco Vessel Traffic Service. The server automatically packages and distributes the information to the clients via the Internet. Shore-side clients, such as the VTS, Marine Exchange, and other waterway managers, as well as a variety of non-governmental users, may access the information via their normal Internet service providers or via the WISP in a manner similar to the waterborne clients. As mentioned earlier, the ultimate AIS communications scheme will differ from the system that was chosen for this research project.

Figure 4. Example of a Transview display using a raster chart. A small portion of the Transview display on a raster chart background is shown. Vessel "APL_Turquo" is beginning to pass under the Oakland Bridge. The line projecting to the Southeast of the ship icon is a dead reckoning vector based upon the reported speed and course over ground contained in the most recent report (age 29 seconds). The projection is based upon a three-minute estimate.



Currently there are ten experimental AIS-like units installed on vessels in the San Francisco Bay area (three pilot boats, four ferries, and three tugs). They automatically report each vessel's position, speed, and course as provided by the ships' own GPS. The information received from the server, which includes the reports from other vessels as well as the environmental sensor data, is displayed to the mariner on a PC using government-owned software named Transview. Transview presents the received reports against a geographic background. A variety of display options and features are available.

The presentation shown in figure 4 is only one of many possible choices available using Transview. A view using a simple vector chart of the central bay area is shown in figure 5.

This experimental system began operation in September 1998. The near-term plan is to continue operating the system full time. The international community is presently developing recommendations for a Universal AIS (U.AIS) system design under the IMO (International Maritime Organization), and the R&D Center is planning to convert this experimental system to the IMO form of AIS technology in the future. Our research plans will be coordinated with the State of California's grant to install U.AIS equipment on selected vessels in the Bay area. Coordination of our efforts with the state of California will enable this research to investigate improvements to AIS at reduced cost and with critical feedback on feature utility by a marine community knowledgeable about the impact that real-time information can have on marine operations. Additional partners in this research are also welcome.

This research directly supports the Department of Transportation's interest in ensuring that navigation assistance is adequately provided to the entire marine transportation system. Managing the waterway by providing timely information maintains order and predictability of traffic flow while maximizing the waterway system's capacity for safe vessel movement. Navigation safety depends on ensuring mariners have inexpensive and reliable access to accurate information on all matters pertaining to the waterway, the activity within the waterway, and the vessels transiting the waterways. The development and introduction of new technologies that can provide automated information involves more than the mechanics of moving information. It involves a sensitivity to, and understanding of, the true operational needs of the mariner. This project experiments with the broad spectrum of issues surrounding the challenges of gathering, moving, and presenting water-

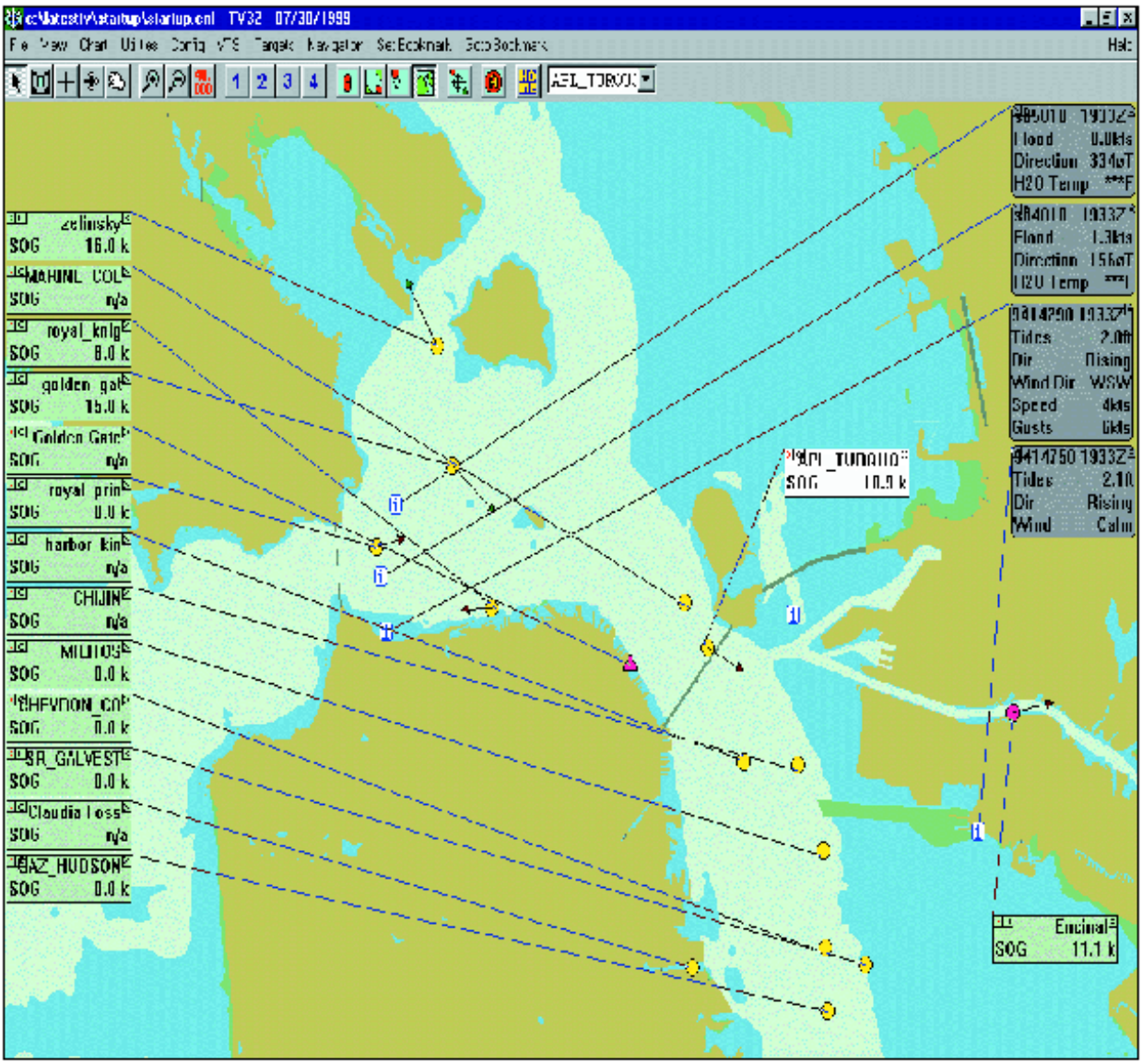


Figure 5. Example of Transview display using a simple vector chart and showing vessels moving in the San Francisco Bay area. This view includes information about other vessels operating in the area. Of the fourteen other vessels shown, six of them (names in all upper CASE) are reported from the VTS radar system, five of them (names in all lower case) are based on voice reports received by the VTS, and three (Golden Gate, Claudia Foss, and Encinal) are automatic reports from our experimental AIS-like units installed aboard these vessels. The display also shows NOAA PORTS (Physical Oceanographic Real Time System) environmental data provided by sensors at the locations marked by the small white icon boxes ("i"). This information is updated every six minutes.

way information to marine navigators in a fashion that meets their needs.

Aid Mix

The Coast Guard has developed an extensive array of aids to navigation (AtoN) and related sources of information to ensure safe and efficient marine transportation. As technology has advanced, additional systems have been added to the mixture of aids to navigation and shipboard navigational aids available to the mariner. Recent additions to the mariner's suite of navigational tools include the Differential Global Positioning System (DGPS), Electronic Chart Systems (ECS), and Electronic Chart Display and Information Systems (ECDIS). AIS technology is also poised to provide improved access to information to commercial users. These systems will ultimately provide the user with a level of service that is substantially greater than that previously available. However, the promise of the new technologies has come with complications. The implementation of these systems brings up a host of related design and human factors issues, and concerns have been raised that improper integration and use of these technologies might actually increase risk on the waterways. As a result, the Coast Guard needs to take a comprehensive look at the entire aid system mix (aids to navigation and navigational aids) and determine the types of information

and visual, auditory, and electronic systems that are necessary today and in the future to enhance mobility and safety on the waterways. The objective of this research is to develop the information, methods, and tools to support the Aids to Navigation program manager in determining the future AtoN System requirements and related program policies and strategies.

The first phase of the Aid Mix study is focused on improving the Coast Guard's understanding of users' requirements for aids to navigation, and the development of a tool to assess navigation performance as a function of aid systems available. The study of users' requirements will seek to identify what navigation information is required, and how mariners use aids to navigation, particularly various combinations of visual aids, electronic aids and navigational aids on board their vessel to acquire this information. Data and expert opinion collected from a complete array of user groups will be analyzed to determine these requirements. Any proposed alternative to the current aid mix will be evaluated to see how well it satisfies the users' requirements.

In addition to satisfying users' requirements, the Aid Mix must also provide adequate navigation performance. A prototype Navigational Aid Analysis Tool (NAAT) is being developed to help assess this aspect of the system. NAAT is designed to evaluate the use of visual navigation, radar navigation, and electronic navigation and determine overall navigation performance of a designated waterway. This approach uses a Markhov chain technique that incorporates performance and failure probabilities of available aids to compute the likelihood of an "incident" given various navigation scenarios as input. The result of a scenario analysis will be compared to a reference incident rate as a measure of the performance of the Aid Mix used in the scenario.

Work has recently started to develop an appropriate analysis methodology for the Aid Mix problem. The approach will incorporate the user requirements information and NAAT assessment in analyzing the Aid Mix alternatives. Due to the need to be as cost effective as possible, the impact on overall system cost must also be considered. This is significant when considering the impacts of the Aid Mix on the support infrastructure, including personnel, maintenance platforms, and operating tempo. If the resulting analysis methodology is effective, the next step will be to formalize the approach in a decision support tool. The tool will eventually be delivered to the Office of Aids to Navigation (G-OPN) for use in evaluating system alternatives and future requirements.

The development of a GIS to display geo-referenced waterway information is also under consideration. Such things as aids to navigation, traffic and commodity flows, NAAT incident rates, WET evaluation scores, and relative risk factors can be presented to provide insight on system characteristics. This task would include an effort to improve the utility of some of the waterway information already collected by the Coast Guard and other agencies.

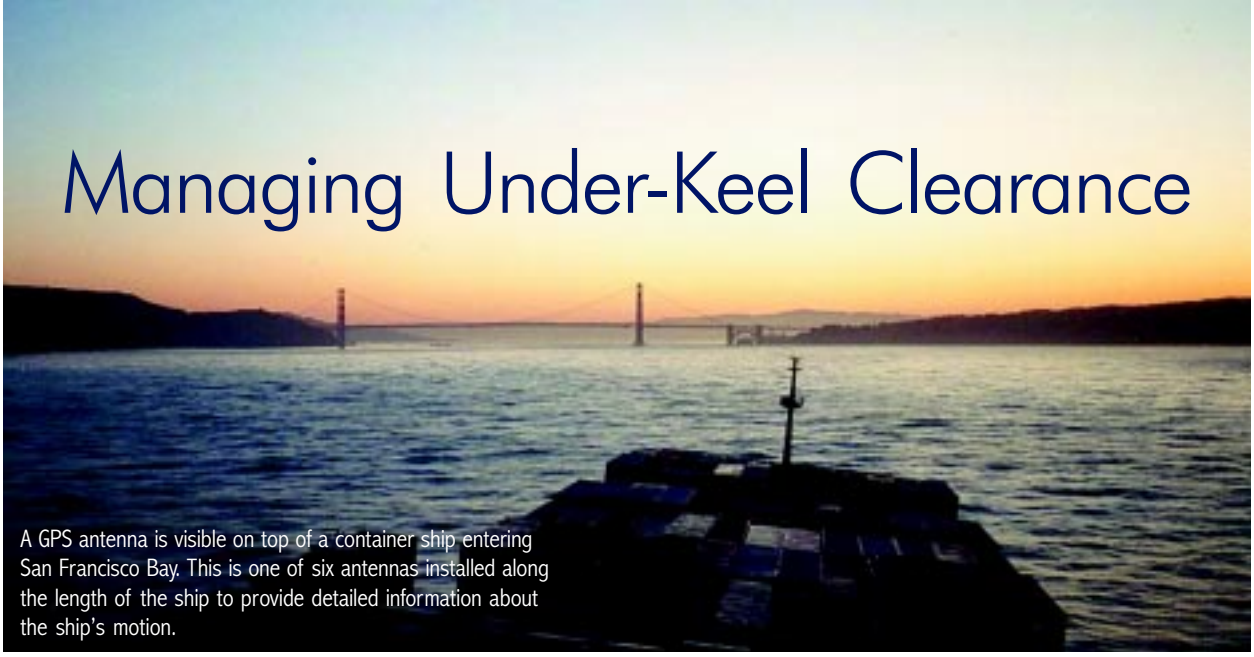
A key goal within the Aid Mix investigation is separating the mariner's information requirements from the desire to retain certain aids or an aid type as the only means to convey that information. Fundamentally, the Coast Guard's mission is to provide the mariner with the information necessary for safe and efficient marine transportation. Timely advances in several technology areas now provide the opportunity to rethink the aids to navigation system that is used to provide much of this information. Aid Mix alternatives for the future may rely more on radio navigation systems and other electronic means of distributing information. Electronic charts, automatic identification systems, and augmented reality are just some of the ways in which this may be accomplished. While these advances in technology may represent a true revolution in navigation, safe and effective implementation may require a process of guided evolution. The related issues of user training, multi-system integration and coordination, and development of appropriate standards and regulations require thorough consideration as we move toward the Aid Mix of the future.

Recognizing the broad nature of waterways management, the R&D Center supports the efforts of the Interagency Committee on Waterways Management (ICWWM) by participating in the R&D Subcommittee. A principle activity of this subcommittee is to foster coordination of federal waterways management research through a biennial conference. In addition to sharing information on research efforts, the most recent conference (November 1999 in Washington, DC) was focused on a recommendation from the MTS Task Force Report to Congress to establish a National Cooperative Research and Development Program. The topics in this article were discussed, along with many others relating to Marine Transportation System research and development.

Additional information on the subjects within this article may be found at the following Web sites.
AIS: **http://radioaid.rdc.uscg.mil/UAIS/**
Aid Mix: **http://aidmix.rdc.uscg.mil/**
MTS R&D Coordination Conference: **http://www.waterways-RD.gov/conf99.html**

The author wishes to acknowledge major contributions to this article by the following staff at the R&D Center: Mr. Warren Heerlein (WET) and Mr. David Pietraszewski (AIS).

Managing Under-Keel Clearance



A GPS antenna is visible on top of a container ship entering San Francisco Bay. This is one of six antennas installed along the length of the ship to provide detailed information about the ship's motion.

By Bruce Parker, Chief, Coast Survey Development Laboratory (CSDL), Office of Coast Survey in NOAA's National Ocean Service, Silver Spring, Maryland, and Lloyd C. Huff, Senior Scientist, NOAA-UNH Joint Hydrographic Center, University of New Hampshire

Introduction

Under-keel clearance became a critical factor in safe and efficient navigation when modern tankers and cargo vessels became so large that they could not enter U.S. ports except near times of high water. Because inaccurate determination of under-keel clearance can have serious safety and/or economic consequences, many ports provide guidelines for minimum under-keel clearance in their navigation channels. These guidelines essentially provide a safety margin that reflects their best judgment on present capabilities to determine under-keel clearance in their waterways. They can be based on such things as how recently depths on nautical charts have been updated by hydrographic surveys, or how much the wind could possibly lower the water level below the predicted tide.

If guidelines such as these require too much under-keel clearance, then the result can be economic losses due to less cargo being carried, unnecessary lightering, or unnecessary delay while waiting outside the entrance for higher water. If guidelines allow very little under-keel clearance, then groundings may occur, which could have economic consequences if the grounding closes the port or leads to property damage, as well as environmental consequences if a hazardous spill results. When ships have too little under-keel clearance they also can lose maneuverability, which can lead to collisions.

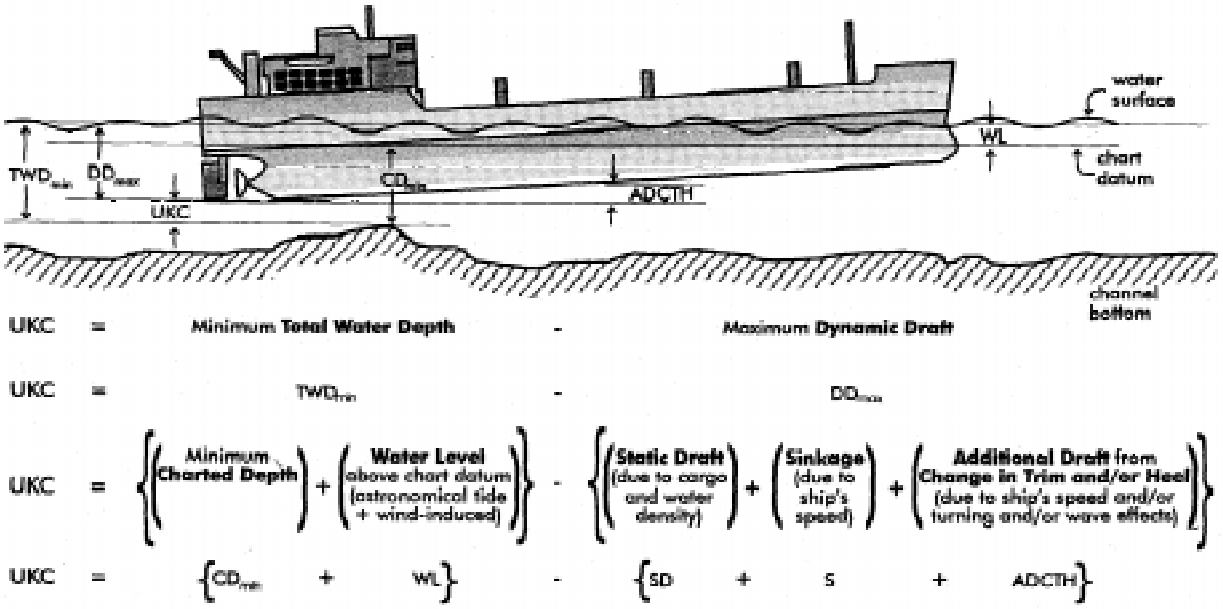
Our ability to accurately predict under-keel clearance, and thus to allow more cargo to be transported more safely, has improved greatly due to recent technological advances in telecommunications, computer power, measurement sensors (including satellites), global positioning system (GPS), oceanographic and weather forecast models, and ship-motion computer models. Many ports will soon have the real-time and forecast information and supporting vessel response analyses needed for effective under-keel clearance management.

The elements of under-keel clearance

Under-keel clearance is the term commonly used to define the distance between the lowest point on the ship's keel (or hull) and the highest point on the channel bottom beneath the ship. Under-keel clearance is equal to the *total water depth* (charted depth plus water level above chart datum) at the location of the ship minus the *dynamic draft of the ship* (the dynamic draft being the distance from the water's surface to the lowest point on the ship's keel while the ship is in motion).

The water level above (and sometimes below) chart datum varies with time, often significantly over time periods as short as a few hours. In many ports water level variation is often dominated by the *astronomical tide*, and the mariner has generally relied on published Tide Tables for the best available prediction of water level at any given time. However, water level can also be affected significantly by meteorological phenomena such as atmospheric pressure, river discharge, water temperature, and especially the wind. None of these effects can be included in Tide Table predictions. Even for locations where the tide dominates, it does not take much wind to affect water level enough (and thus under-keel clearance) to have a serious economic or safety consequence if it is not taken into consideration.

Dynamic draft also has a number of components. The *static draft* (the draft of the ship when it is not moving) is primarily affected by how much cargo is loaded and where it is placed in the ship. If the cargo is not loaded symmetrically it can affect the



Elements of under-keel clearance.

ship's *trim* (the stern-to-bow angle of the ship relative to the horizontal) and/or its *list* (the ship's port-to-starboard angle relative to the horizontal). The static draft can also be affected by *water density* being greater in fresher water where the ship has less buoyancy. For example, a full-form ship with a draft of 15 m in open sea may experience an increase of up to 45 cm in draft when entering a port that is significantly fresher than sea water.

Once the ship is in motion, there are a number of other effects on the ship's draft. A ship in motion sinks lower in the water (referred to as *sinkage* or *settlement*) and changes its trim (sometimes referred to as *squat*, but the term squat is often used to represent both the sinkage and the change in trim). When a ship makes a turn the ship's *heel* (its port-to-starboard angle) will change. When any of these effects change the lowest point of the ship's keel in the water, then the effective draft is changed. All of these dynamic effects on draft depend on the design of the vessel, its static draft, the depth of the water, the speed of the vessel, and the speed and direction of the currents. Dynamic draft can also be affected by waves and swell. The *heave* (vertical up and down motion of the entire hull), the *pitch* (the angular up and down motion of the bow and stern in opposite directions), and the *roll* (the angular up and down motion of the port and starboard sides of the ship in opposite directions) can contribute to the maximum draft.

Under-keel clearance management

A ship's master can effectively manage the under-keel clearance of his ship in two ways. While enroute to or out of port he can take actions that affect his ship's dynamic draft, such as changing the speed of his ship. Prior to leaving or entering a waterway, he can plan his schedule to ensure that there will be sufficient water level for safe passage when he reaches locations with controlling depths along his route. Both types of actions are dependent on having real-time and forecast environmental information and supporting analyses of his ship's motion in varying situations, in addition to having accurate nautical charts. Both types of actions will have economic consequences that he will take into consideration when making his decisions.

A ship's master can increase under-keel clearance by slowing his ship (and reducing its dynamic draft). This action will have economic repercussions such as arriving later at the pier, so he must have the necessary information to determine exactly how much he will have to slow down to avoid grounding (or to stay within the port's minimum under-keel clearance guidelines). If there is a real-time water level system in that port he will have up-to-date accurate information about the total available water depth. To determine how much his desired ship speed will add to his ship's draft and how much he must slow down to pass safely over controlling depths, he must have vessel response formulas for his *specific ship* in those *specific channels* for the *same water level conditions* that he will soon face.

For a ship's master to be able to plan for his ship to arrive at locations with controlling depths at times when there will be sufficient water depth for safe passage, he must have accurate forecasts of water levels. If he is leaving port, such forecast water level information will tell him the best time to safely leave the port and/or bay. It will also tell the shipper how much cargo he can safely load. If he is bringing a ship into port, he can plan the ship's arrival at the entrance to the port to coincide with a high enough water level to safely enter, or he can plan for the ship to safely pass a location with controlling depth further up the bay on the way to a port. Tide predictions do not include wind or river effects on water level, and real-time water level data will generally not be applicable more than a couple hours into the future.

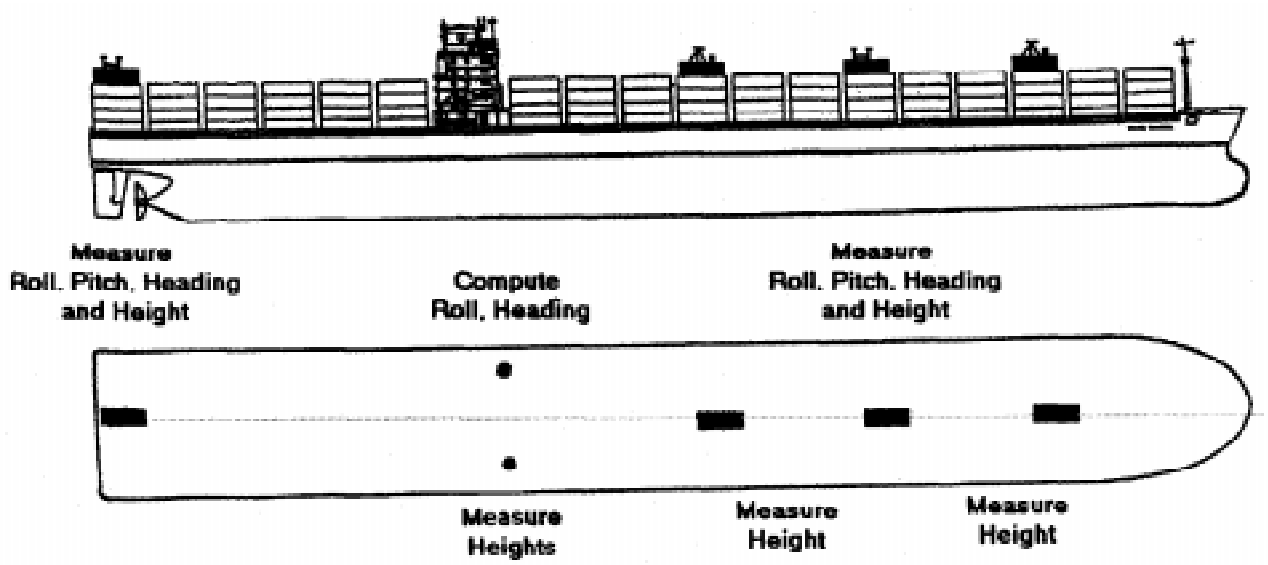
In order for the ship's master to be able to accurately manage his ship's under-keel clearance, he must—at a minimum—know the ship's static draft and have accurate information along his route on: (1) charted depths and underwater hazards; (2) water levels (real-time and forecast out to 24 hours into the future, as well as tide predictions); and (3) channel-specific ship-specific formulas for dynamic draft (based on ship speed, static draft, turning requirements, and water depth). The dynamic draft calculation may also require information on: (4) currents, where they are large enough to have an effect; (5) water density, for ports where river discharge can be significant; and (6) waves, swell, and seiching (an oscillation of the surface of a body of water that varies in period from a few minutes to several hours), for ports on the open coast. The systems that will provide this information include: (a) modern electronic nautical chart systems and their supporting rapid update services [providing item (1) above]; (b) modern hydrographic measurement systems, such as shallow-water multibeam and high-speed high-resolution side-scan sonar systems [providing the data for item (a)]; (c) real-time oceanographic systems [providing real-time information for item (2) at selected locations, as well as for items (4)-(6) for some ports]; (d) nowcast/forecast oceanographic model systems [providing real-time information for items (2), (4), (5), and (6) at hundreds of locations where there are no sensors installed, as well as forecasts (out to 24 hours) for these same items]; (e) vessel response prediction systems [providing item (3)]; and (f) real-time kinematic (RTK) GPS systems [providing data on ship motion, which, when combined with data from the above systems, can be used to validate vessel response prediction systems in item (e)].

Nowcast/forecast oceanographic model systems

When ships became large enough that the wind-induced changes in water level could not be ignored, *real-time water level measurement systems*, such as PORTS (Physical Oceanographic Real-Time Systems) operated by NOAA's National Ocean Service (NOS) [see *Proceedings,* Vol. 52, No. 5, pp. 30-32] began to be installed. Advances in telecommunications (satellites, the Internet, cellular phones, and HF radio) allow the user to have observed water level data within minutes of its measurement, instead of having to rely on astronomical tide predictions. These real-time water level data fulfilled the short-term needs of the mariner at a few locations considered most critical in each port. Using this information, the pilot and the master on a ship approaching an area with a controlling depth could either: feel confident about safe passage beyond this point; take action to slow down the ship to reduce dynamic draft and increase under-keel clearance; or stop the ship if there would not be enough under-keel clearance no matter how much the ship slowed.

Real-time water level measurement systems, however, do not provide information at locations where there are no water level gauges. And more importantly, real-time systems do not provide water level information into the future, so a ship's master cannot accurately schedule his ship's transit of the planned route, or know how much cargo he can safely load. The next step therefore was the development of *nowcast/forecast oceanographic model systems* driven by real-time data fields and forecast fields from weather models. Such model systems can provide: nowcast (real-time) water levels at hundreds of locations; forecast water levels 24 hours or longer into the future; as well as

Several GPS antennas like the one at right were installed on this container ship in order to measure the ship's squat while in transit.



Schematic layout of multiple GPS antennas/receivers on a container ship for the study of squat.

nowcasts and forecasts of other oceanographic parameters that may be needed in determining dynamic draft, such as currents, water density (from temperature and salinity), and waves, swell, and seiches.

A nowcast/forecast model system involves not only the numerical hydrodynamic model of the port (or of the bay where the port is located), but also many sources of real-time oceanographic and meteorological data fields, as well as forecast fields from other oceanographic and weather models. Forecast open boundary conditions at the bay or port entrance must be provided by a *coastal ocean forecast model* (e.g., for the entire East Coast of the country), which must be driven with wind and other meteorological fields from a *large weather forecast model*. For large bays with complex geometries, forecast wind fields over the bay itself must be provided by a high-resolution weather forecast model, with lateral boundary conditions provided by the same large weather forecast model that drives the coastal ocean forecast model.

The complexity of implementing the components of a nowcast/forecast model system no longer presents major problems because of recent improvements in telecommunications, measurement sensors and real-time delivery systems, computer power, weather forecast models, and oceanographic models, as well as increasing sources of real-time data maintained by various agencies. The primary issues remaining for nowcast/forecast model systems are those dealing with maximizing their *prediction skill*. Skillful water level forecasts from a port or bay model system ultimately depend on skillful weather forecasts, but the first 6 hours or so of the forecast are greatly affected by the quality of the last nowcast (which can be improved by using the latest techniques to assimilate all available real-time data). It is also important to be able to provide an *uncertainty estimate* that accompanies (and is different for) each new forecast, to let the pilot or master know what the probability is that the forecast will be accurate.

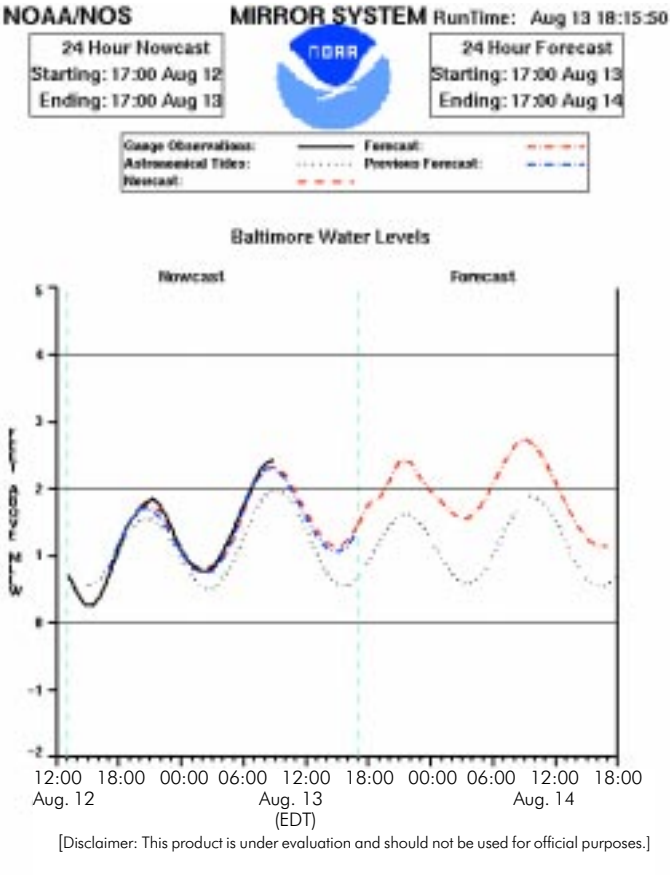
NOS is running (in a quasi-operational environment for testing) three nowcast/forecast model systems with outputs provided on Web sites: Chesapeake Bay, the Port of New York and New Jersey, and Galveston Bay. The Chesapeake Bay forecast model system is now being transitioned to the 24/7 operational PORTS environment; the others will follow.

Vessel response prediction systems

Vessel response predictors are formulas or computer models used to predict the dynamic draft of a ship in motion. A vessel response predictor will usually include static, dynamic, and wave-induced responses of vessels under any combination of environmental conditions and operating parameters of the ship. A floating vessel, as a rigid body, can move in six different ways, i.e., translating motions along the x, y, and z axes (surge, sway, and heave), and rotating motions around these three axes (roll, pitch, and yaw). The vessel is also subject to bending. When a ship is moving, the dynamic components of vessel response prediction are basically heeling (due to turning), and settlement and changes in trim (termed together as *squat*). Heel, squat, wave motion, and other hydrodynamic phenomena can cause problems for vessels operating in very restricted waterways. When a vessel is turning steadily, the magnitude of the heeling depends on the vessel speed, turning radius, and the transverse metacentric height. Vessels like tankers and container ships that have wide beams and large sections of flat plate keel may experience a dramatic decrease in under-keel clearance in conjunction with a heeling. Squat increases with the square of the ship speed. The early simplified squat predictors did not take into consideration ship size, detailed ship geometry, or water depth, nor the effects of channel side walls or of finite depths. To improve on the conservative (over-predicting) estimates of squat based on highly stylized methodologies, it is necessary to

validate and/or adjust the results of scaled-ship model work or computer studies with actual full-scale measurements of squat. Such full-scale measurements must be conducted in particular reaches of a given waterway under a variety of operating conditions, including accelerations, decelerations, static draft and trim, residual flow fields, and still-water depths.

Real-time kinematic (RTK) GPS technology is a tool that can be used for full-scale measurements of three-dimensional ship trajectories as they are passing in or out of harbors. Those trajectories, in conjunction with accurate knowledge of the seabed, readily yield accurate under-keel clearance time histories of the ships which can be used to validate the squat and heel from a vessel response predictor system under the given environmental conditions and operating parameters of the ship. NOS has instrumented container ships that transit San Francisco Bay with GPS antennas at several positions along the full extent of the hull. The measured vertical trajectories of the two GPS antennas, mounted port and starboard on the bridge, each contain the signature affects of vessel heeling and rolling. An average of the two bridge trajectories suppresses the heel and roll but preserves the effects of squat on center keel draft.



Sample Web page graphical output showing nowcast and forecast water levels at the Port of Baltimore from the Chesapeake Bay model system.

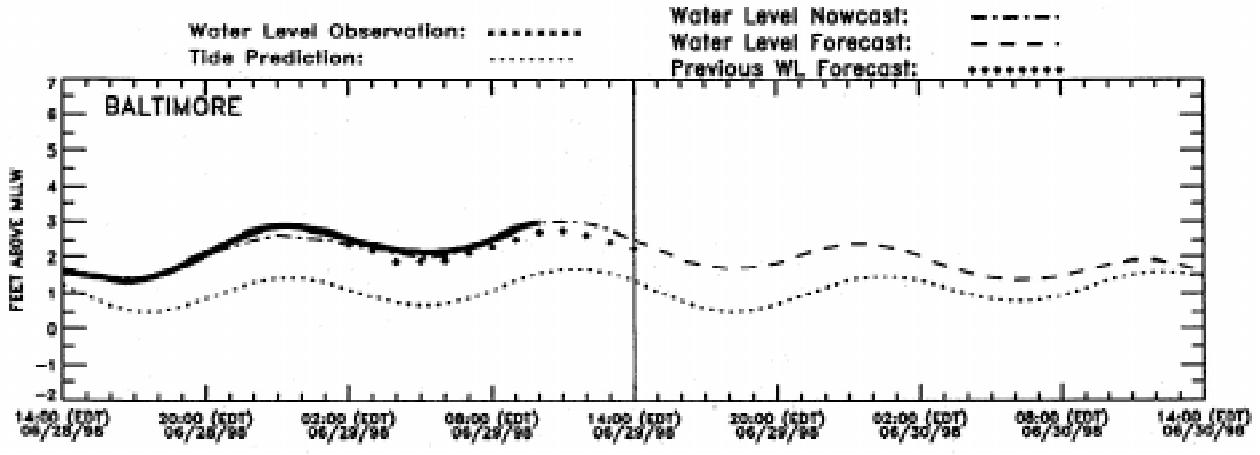
Improvements in hydrographic survey and nautical chart systems

Depth soundings and underwater wrecks/hazards, presented on nautical charts, have always been a basic component of under-keel clearance determination. Recent advances in hydrographic and cartographic systems have led to more accurate data that are provided more quickly to the mariner in more useful forms.

There have been great strides in survey technologies leading to increased efficiency and accuracy with which hydrographic data are acquired. Shallow-water multibeam survey systems provide accurate and detailed documentation of the configuration of the natural seabed and/or maintained channels, as well as the geographic positions of discrete obstructions or shoal areas. Accurate information on underwater obstructions are acquired using a high-speed, high-resolution side-scan sonar system. Through the high quality of its data and its increased allowable tow speeds, this new technology presents a great improvement in productivity. The biggest challenge at the moment with both of these acoustic systems has been how to efficiently handle the huge quantities of data that these systems produce.

How accurately the depth soundings acquired during a hydrographic survey are referenced to a chart datum (such as MLLW) is also extremely important. This has traditionally meant subtracting measured water levels from the depth soundings, and has required the installation of tide gauges in the area of the hydrographic survey, as well as some technique for interpolating or extrapolating the water level from these few gauges to all other points in the survey area (for example, a *tidal zoning* technique). Water level zoning techniques in an area to be surveyed can be improved by using a numerical hydrodynamic model to provide the geospatial variation of all major tidal constituents, as well as the geospatial variation in the wind-induced water level signal. An even more attractive approach for accurately measuring depths with respect to a common (chart) datum involves the use of RTK-GPS on a moving ship. Since the transducer of a shallow-water multibeam system is at a known position below a GPS receiver on the ship, the depth measurements taken are known relative to the ellipsoid. If the geographic distribution of the chart datum (e.g., MLLW) with respect to the ellipsoid is determined in advance, then the measured depths can be directly referenced to the chart datum (and no tide gauges must be installed during the survey). This geographic variation in the chart datum (with respect to the ellipsoid) can be determined using a numerical hydrodynamic model. Using RTK-GPS also eliminates the need to correct the depth soundings for the effects the survey vessel's dynamic draft.

This GPS approach has been made possible by the centimeter accuracy now achievable in the ver-



NOAA/National Ocean Service 24-hour water level forecast.

tical through RTK-GPS techniques. However, using this technology for continuous operation on a moving hydrographic survey ship can lead to occasional data gaps or to the ship having to cease data acquisition at times. The cycle slips during data processing can be caused by multipath problems (for example, the corruption of the direct GPS signal by reflected signals from the local surroundings), loss of phase-lock on the signal carrier, or by not receiving the signal transmitted from several satellites. There are several ongoing research efforts by NOS, private industry, academia, and other government research units to develop on-the-fly (OTF) GPS techniques to automatically detect and rapidly repair all carrier phase cycle slips found while processing GPS phase data.

Recent advances in raster and vector digital chart production techniques are allowing NOS and other hydrographic agencies to develop *rapid update services* that keep will their nautical charts continually updated. Combined with Internet access and a *print-on-demand* capability, this will allow the mariner to acquire charts with the latest available information. Such information can be updated within one to two weeks of receiving new information—a dramatic difference from the six-month to a year time periods it used to take to put out a revised chart. This same digital chart capability has led to the development of electronic navigational charts (ENCs) and electronic chart display and information systems (ECDISs). They provide not only more user-friendly and accurate ways for a pilot or master to view the bottom of a waterway, but also offer a potential vehicle to display under-keel clearance predictions over an entire waterway. It has been suggested that real-time (or forecast) water levels could be used to actually change the depths and depth contours displayed on an ECDIS. However, since water level (and its largest component, the tide) often vary considerably over distances, real-time water levels from one or more gauges cannot simply be added to the all charted depths, nor will simple interpolation between tide gauges work in most cases. What is required is a nowcast/forecast model system to provide water levels at hundreds of locations in the bay or port. An ECDIS (combined with a water-level forecast model system) might eventually allow for the input of critical ship parameters for determining dynamic draft that could be used to predict under-keel clearance along the ship's route based on the planned speed of the ship and the required turns. Many of the potential benefits of ECDIS result from its ability to generate warnings. An ECDIS could warn of insufficient under-keel clearance somewhere along the ship's remaining route and suggest changes in ship speed to avoid the upcoming problem.

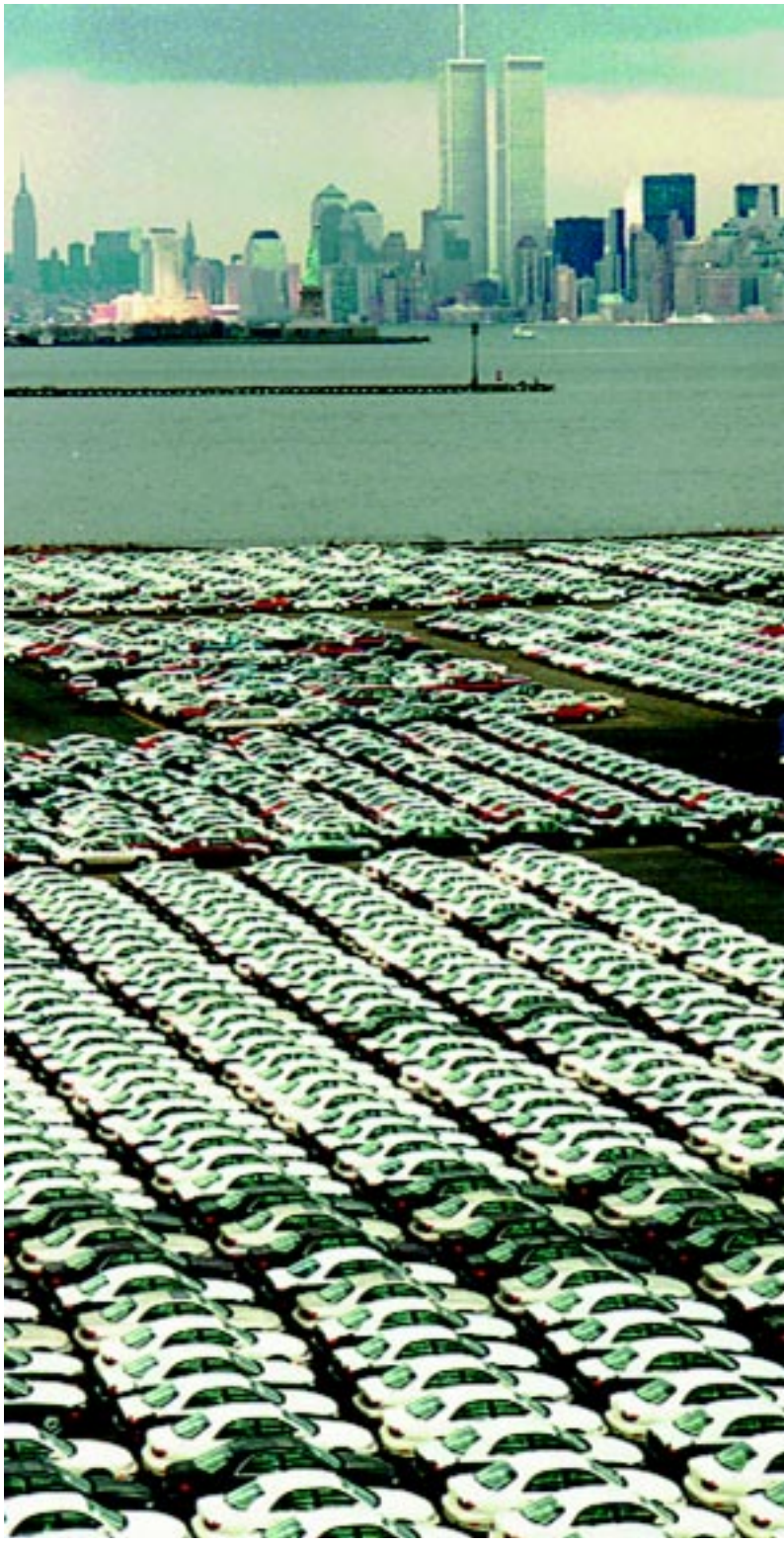
In addition, some vessel traffic services (VTS) will use a digital navigational safety broadcast service and two-way communications that would allow the vessels to inform the VTS center of their operating conditions. This usually includes vessel identification, position, course, speed, and projected travel times to particular restricted areas. The two-way communications may someday inform ships that they would be passing sufficiently close to another ship such that the squat-causing surface depressions traveling along with each ship might combine to significantly decrease the under-keel clearance of both of the ships as they pass.

Conclusions

Managing under-keel clearance will become a reality when ports implement real-time and nowcast/forecast model systems, and ships use improved vessel response prediction systems (validated with ship motion data from RTK-GPS studies). Accurate charted depths and underwater hazards, water levels, and ship-specific channel-specific prediction formulas for dynamic draft will be provided. The ship's master will be able to schedule a planned route to ensure that there will be sufficient total water depth for safe passage and to take precise actions that affect the ship's dynamic draft if necessary. The result will be maximum port throughput at minimum risk.

MEETING THE CHALLENGE OF AN INTEGRATED INFORMATION SYSTEM IN THE PORT OF NEW YORK AND NEW JERSEY

By LT Michael Day, Chief, Waterways Oversight Branch at Coast Guard Activities New York
and
Thomas Wakeman III, Dredging Program Manager, Port Authority of New York and New Jersey



The steady growth of the global economy and expansion of international trade puts pressure on the collective performance of the maritime community, whether federal agencies, regional transportation agencies, port authorities, businesses or private organizations. Port-to-port competition, global economic changes, budgetary restrictions, increased costs, technological shifts and changes in vessel traffic, design and infrastructure requirements are ever increasing challenges to world ports. Any interruptions or delays to the rapid movement of products or commodities between trading partners can impair a nation's economic competitiveness.

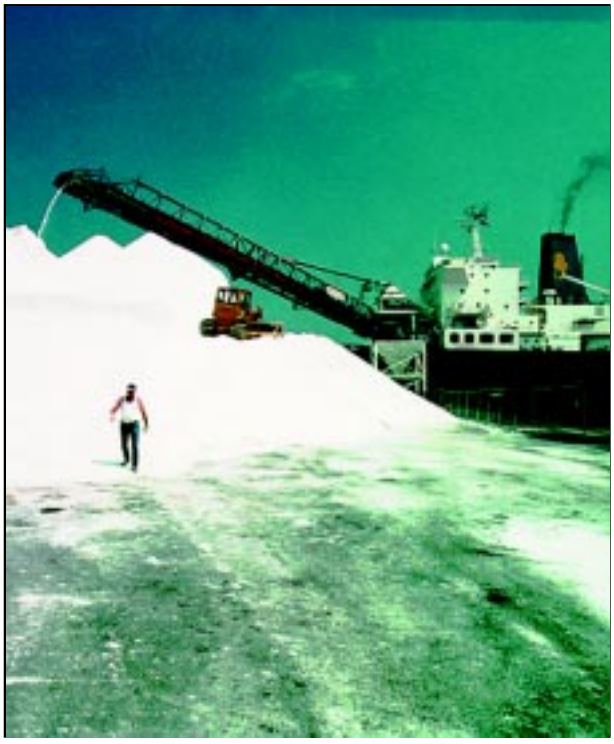
Approximately 95% of the United State's international cargo, by volume, enters or leave the country through the nation's ports and waterways.[1] Movement of cargo is the underlying business of the maritime industry, whether during times of peace or war. Cargo in the 21st century will have to move seamlessly from producer to sea to retailer; anything less will result in the diversion of cargo to ports where it can be moved to market quicker. Accomplishment of a new vision of maritime transportation efficiency and effectiveness will require cooperation and merging of the collective resources of the port community. Some estimates suggest that by the year 2010 the Port of New York and New Jersey will see a doubling in the number of containers destined for the area and that by 2040 a quadrupling of cargo volume.[2] Increased vessel traffic will not be the only effect of the inevitable growth in trade. As importers and exporters continue their relentless drive to take time and cost out of the sup-

[1] United States Department of Transportation, *An Assessment of The U.S. Marine Transportation System: A Report To Congress*, September, 1999: 1

[2] The Port Authority of New York & New Jersey, Port Perspectives (Fall 1998)

ply chain, they are pressuring ports to improve productivity. Large retailers who move thousands of containers each year are the driving force behind this contraction of the supply chain.[3]

Port infrastructure has traditionally summoned images of piers, docks and wharves, hoists and cranes, and terminals and warehouses to mind. However, port infrastructure should be conceptualized as more than just the physical hardware. Anchorages, vessel traffic systems, deep draft channels, and navigation aids must also be considered. Ports now should be viewed as a comprehensive waterway infrastructure which must rely on the landside infrastructure to support and match the delivery of the waterside and port infrastructure. Ports must also include information and communication capabilities that links waterway data with ships and landside facilities. Information and communications are what makes the modern intermodal transportation system, international or domestic, function.[4] Navigation tools, including electronic charts, differential global positioning systems, and vessel automatic identification systems (AIS) will also be needed to ensure safe vessel movements for the new generation of ships coming into service as will adequate water depths and channel designs that support the maneuvering of these ships. *The future is now.* Today's ports' need for efficient, effective, and affordable systems that integrate waterways management and port management have never been more crucial. Without such systems, it is difficult to imagine how ports will handle the projected expanding volume of cargo projected in the 21st century.



The achievement of this comprehensive vision of an integrated waterway and port management system requires a new approach to vessel and port operations. As marine economic activity drives the expansion of the size, speed, and number of vessels in service, it will likely increase waterway congestion, which has the potential of creating additional risk for people, property, and the environment. It is not just a change in the intensity of commercial activities that will be a factor in the future waterways milieu. Other trends bound to contribute to waterway congestion include the proliferation of high-speed commercial craft; the resurgence of ferries; water-taxis quickly moving people to central locations; and the increased popularity of recreational boating. As the public nationwide returns to the waterfront, their desires for transportation and recreational access have placed additional demands on ports to maintain mobility and safety in local waterways. According to the MTS Report, over 78 million Americans participate in recreational boating activities each year.[5] The MTS Report supports the development of a system of "Information Management and Infrastructure."[6] For all these reasons, the development of a comprehensive port information system takes on additional importance – to enhance mobility, to increase safety, and to provide an additional measure of environmental protection.

One of the questions we must ask ourselves is: How do we, as waterways managers, reconcile the competing demands of increased volume of deep draft vessel traffic *against* the industry demand for speed and efficiency *while* still maintaining a commensurate level of safety the public has become accustomed to? The maritime community of the Port of New York and New Jersey proposes to respond to this challenge by embarking on an ambitious two-phase approach that will include a landside and a maritime component that will eventually be merged to form an integrated information system. This two-phase approach embraces an MTS theme that ports in the new millennium should be viewed as a comprehensive waterway infrastructure that does not end at the "water's edge."

The landslide component is titled the Freight Information Real-time System for Transportation, or FIRST. The FIRST will focus on efficiencies for

[3] Mongelluzo, William, "Supply Chain Pressures Hit Ports, Terminals," Journal of Commerce, March 3, 1999: A1

[4] Borrone, Lillian. "Focus on Users Needs" speech given at Federal Waterways R&D Coordination Conference. May 20, 1997

[5] United States Department of Transportation, *An Assessment of The U.S. Marine Transportation System: A Report To Congress*, September, 1999: 1

[6] *Ibid,* Pg. 83

landside intermodal terminal operators as well as for the trucking and railroad industries. Ultimately the customers who ship their products via ocean carriers will benefit from this optimization of each link of the intermodal chain. Avoiding gridlock as ships deposit containers *en masse* on the dock will require a coordinated effort among the shipping lines, terminal operators, railroads and truck lines to share information on vessel arrivals and departures, gate hours, equipment availability, and even local weather conditions.[7] The exchange of real-time information is seen as a means of improving the movement of commercial vehicles along the I-95 corridor and through local access roads of the port. Terminal operators, consequently, would be better able to pinpoint deliveries and pick-up of cargo and containers, thereby easing congestion at terminals and more efficiently using manpower. An additional benefit would be the reduction of truck idling time, which would cause a corresponding reduction of emissions and improved air quality. Other technologies being examined include two-way radio communications, electronic pre-gate clearance systems for commercial vehicles, weigh-in-motion technology, graphical information systems and information kiosks.

The maritime component will focus on the development of a Port Information Network System (PINS). Its goal is to improve safety and to increase the efficiency of operations within the Port. Currently, information on port activities is available from a wide array of sources within both the public and private sectors. It's also envisioned that a PINS would include information of interest to companies that support maritime transportation such as each vessel's particulars, its cargo, last port of call, length, vessel name and agent as well as projected sailing times and descriptive information regarding berths within the harbor. Through AIS technology, a graphical display could also show the location of a vessel within the harbor. Cooperation among data generators and users promises to enhance overall port performance.

In essence, both systems will be merged to integrate data from several different sources into one Internet based reference. From a business perspective, at a time when public opinion is requiring (through the Government Performance and Results Act) an increased responsibility for the management of governmental programs, an integrated information infrastructure offers an opportunity to shift the paradigm: to empower private businesses to manage information systems. An integrated information system also offers the prospect of private businesses gaining technological control of information entry and flow so they are empowered to access and to design the service system to meet their needs. Information available from government sources would be "value enhanced" by private entities, at no additional cost to government. To illustrate this point, one idea being explored is the use of the National Oceanic and Atmospheric Administration's (NOAA) Physical Oceanographic Real Time System (PORTS) data as an input component of a Dynamic Underkeel Clearance System (DUKC). The DUKC calculations will enable an even

[7] Mongelluzo, Pg. 14

wider "sailing window" for vessels that are currently restricted by draft, thus increasing port productivity and profitability of shipping lines, since vessels will not be waiting for tides as much. A DUKC will take into account a vessel's operating characteristics and factor in NOAA's data to calculate the actual underkeel clearance of that particular vessel. To a great extent, the use of existing and emerging technology can change the relationship between business and the government into a mutually beneficial partnership.

Representative Bud Schuster recently said he has "plans to make ocean shipping, railroad, trucking, and port infrastructure needed to support the largest oceangoing vessels, a high priority issue in the two-year session of Congress that begins this year." And the Secretary of Transportation Rodney Slater recently noted that "…safety is (his) highest priority" and that his vision for the 21st century includes "…U.S. waters and ports that are the safest, most environmentally sound, and efficient in the world."[8] Building upon both of these commitments to the nation's Marine Transportation System presents us with a unique opportunity, the opportunity to develop and to integrate marine safety and transportation information so it can be used by vessels and maritime industry to achieve these goals. In the Port of New York and New Jersey, this is the opportunity to implement an integrated information system.

It is both feasible and desirable to establish an integrated information network system for the ports and in particular the Port of New York and New Jersey. To illustrate feasibility, there have been two demonstration projects of information technologies that underwent field trials as the basis for the Port's maritime component, PINS. Lockheed-Martin and Northrop-Grumman have each developed a system with different operating attributes; the common denominator of both these systems is the goal of enhancing safety and promoting port productivity. Each technology has the ability to incorporate real-time information from a variety of sources: Potential data sources include, but are not limited to: the U.S. Coast Guard's next generation Vessel Traffic Service (VTS), PORTS, DUKC Sensors, and, laser technology for bridge height detectors. On the landside, global positioning systems for trucks as well as refining cargo tracking are areas deserving of emphasis. The concept of cargo tracking has been used extensively by United Parcel Service (UPS) as well as the U. S. Postal Service to track the location of individual packages during transit. And the Department of Defense has used radio frequency transponder technology to track the location and contents of individual containers. However, there has been limited migration of this technology to containerized cargo. The technology is available; the challenge is to coordinate individual efforts into one singular system that benefits the entire port community in an intelligent cargo transportation system.

In summary, information infrastructure is an important avenue through which maritime safety and market efficiency can be coupled to form a mutually beneficial public-private relationship via the development of an accessible, cost-effective information network. Recreational boaters are reclaiming the waterways with little regard for existing commercial vessel operations. It is not atypical for kayaks to be circling the Statute of Liberty while commercial traffic ply the waters in close proximity. As vessel traffic increases, it is increasingly important that we, as waterway managers, ensure recreational and commercial traffic are able to safely and efficiently use our waterways. In the Port of New York and New Jersey, our goal is to develop and to demonstrate an open, dynamic, versatile, and multi-purpose information system that will streamline access to, and the delivery of, a variety of public and private information sources while maintaining a commensurate level of safety with increased vessel traffic. This system will benefit port users, commercially and operationally. The initiative is shaping a proactive policy in the Port needed to ensure future investment in an information network, services, and meeting program-specific applications to carry the Port into the 21st century.

[8] Slater, Rodney. "Remarks Before the Propeller Club of Washington D.C." May 22, 1997

Waterway and Port Security

By LCDR Kevin Burke, Division of Waterways Security and Safety (G-MWP-2), USCG Headquarters, Washington, DC

With the end of the Cold War, the security environment has changed in ways which few people in the early 1990s could have predicted. Our economy has become globalized. As essentially an island nation and the world's greatest power, the vitality of America's future remains tied to the sea. The sea links us with the world, allowing us to derive the full benefits of trading with an increasingly open post-Cold War world economy. The sea allows us to project our power far from our shores to advance America's vital interests. This openness, however, has left the U.S. and the international community increasingly exposed to transnational threats such as terrorism, weapons proliferation, drugs and migrant smuggling, cargo theft, and environmental crime. This exposure is due to the growing volume of people and goods moving across national borders which makes it harder to separate legitimate from illegitimate activities. In addition, there is growing resentment in many quarters over the real and perceived dominant role the U.S. plays in the international system.

Those who resent us are most likely to attack us asymmetrically. Criminals, terrorists, and the nation's adversaries are taking full advantage of this openness to move contraband or to engage in covert activities that threaten our vital interests. Effectively responding to these trends will require establishing control over the "interspace" within the international system where the writ of the state is weakest. Failed states, the high seas, and the maritime and land border regions define much of that "interspace." Maintaining some control over this space will require:

- The ability to identify and intercept illegitimate activities in an environment made up of primarily legitimate activities.
- The ability to respond rapidly and proportionately to threats that range from honest accidents

and regulatory and civil misconduct to violent criminal acts and terrorism.

• The ability to coordinate effectively with the vast array of agencies whose responsibilities and authorities extend into the interspace.

• The ability to build and sustain constructive working relationships with the legitimate private sector actors who operate within the interspace.

• The authority to operate in both the domestic and international environments that incorporate the interspace.

If one were to invent the ideal agency to respond to the unique security environment of the Marine Transportation System (MTS) of the 21st century, it would have the following attributes:

• The authority and the capability to simultaneously exercise regulatory authority, enforce laws, and engage in armed combat.

• A readiness to work closely and comfortably with both civilian and military authorities.

• A working relationship with legitimate private sector actors based on mutual respect.

• The ability to work successfully in an interagency process.

• The authority and ability to collaborate with international authorities to advance common approaches to shared challenges.

• A closely connected force structure that is placed in the appropriate local, regional, national, and international settings.

• The capability to operate and act decisively in chaotic operational environments.

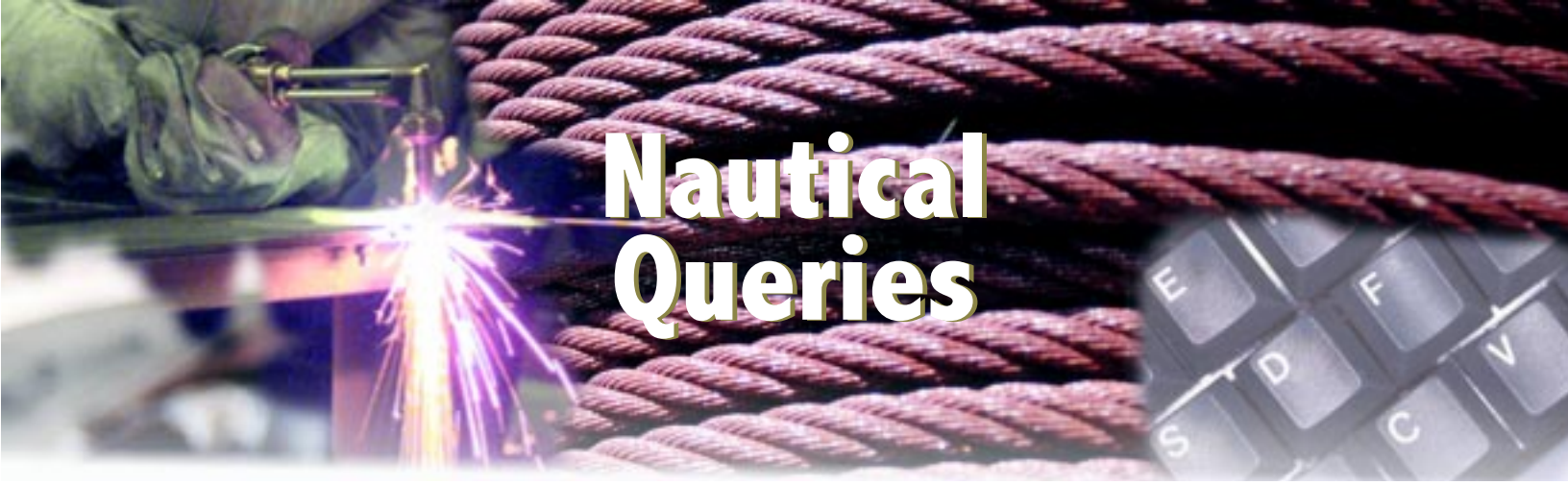
Previous page: The Coast Guard's newest Port Security Raider Boat. Below: A drug sniffing dog and a member of a Coast Guard boarding team inspect a vessel for illegal drugs.

In short, such an agency would require unique capabilities and far-reaching legal authorities. As it turns out, though, there is no need to invent such an agency because the U.S. Coast Guard has acquired these attributes over the last 209 years. Indeed, in this transformed national security environment, the Coast Guard is uniquely positioned to fulfill an instrumental role in safeguarding America's vital interests. It works jointly with the DOD as one of the nation's five armed forces. In combating drugs, intercepting migrants, protecting fisheries, and preventing and responding to threats to our marine environment, it routinely works closely with federal, state, and local agencies and cooperates closely with authorities overseas. In advancing safety on our nation's waterways, it forges and maintains stakeholder relationships with commercial companies, marine operators, and the American public. The service operates on land, at sea, and in the air. The Coast Guard has the unique skill set, force structure, and legal authority to serve as the lead agency in advancing security in our ports, waterways, and coastal approaches.

The Coast Guard will continue to develop and expand its responsibility as the lead federal agency for port security at all MTS facilities and waterways. The Coast Guard will continue to be the leader in surveillance, detection, identification, classification, and prosecution of maritime threats.

At the national level, a Headquarters Division of Waterways Security and Safety (G-MWP-2) was created in the new Waterways Management Directorate (G-MW). Its chief concern will be to invigorate the Coast Guard Port Security program and provide guidance to Marine Safety Offices, Activities, Groups, and Captains of the Port (COTPs) to make our ports and waterways safer and less vulnerable to conventional and asymmetric threats. New guidance and direction on waterways security will be developed to make the Coast Guard ready to face the challenges of the next century. This will include: port vulnerability assessments; a CONUS Port Security program and guidance in homeland defense; training in anti-terrorism; systems to identify and track vessels suspected as security threats; enhancement of our intelligence capability; and enhancement of our ability to prevent and interdict weapons of mass destruction both in our ports and on the seas. The new division will also coordinate implementation of waterways security-related recommendations from the MTS Report to Congress and the President's Interagency Commission on Crime and Security in U. S. Seaports.

We look forward to working with all Coast Guard Commands and other agencies to make our ports and waterways safe environments and Semper Paratus for any contingency.



Nautical Queries

Deck Questions

1. What is the spoken emergency signal for a "man overboard" on the VHF radio?

A. Man Overboard
B. Security
C. Mayday
D. Pan-Pan

2. A survival craft is manufactured with fire retardant ____.

A. foam
B. marine plywood
C. steel
D. fiberglass

3. You are lifting a one-ton weight with a swinging boom. When comparing the stresses on the rig with the boom at 20° to the horizontal to the stresses when the boom is at 60° to the horizontal, which statement is TRUE?

A. The angle of elevation does not change the stresses in the masthead fairlead for the topping lift.
B. The stress on the head block is greater at 60°.
C. The stress on the heel block is greater at 60°.
D. The thrust on the boom is greater at 20°.

4. What characteristic is an advantage of the self-contained demand-type breathing apparatus as compared to the canister-type breathing apparatus?

A. Longer wearing time
B. Weighs less
C. Less awkward and bulky to wear
D. Speed of donning

5. Which form of navigation may be suspended without notice under defense planning?

A. electronic
B. celestial
C. piloting
D. None of the above

6. Rivets are usually made of _____.

A. wrought-iron
B. aluminum
C. high-tensile steel
D. mild steel

7. The minimum amount of lifesaving equipment required aboard an 85-foot uninspected towing vessel consists of _____.

A. one approved flotation cushion for each person on board
B. one approved life preserver for each person on board and one life ring
C. one approved inflatable vest for each person on board
D. lifeboat capacity equal to 1 1/2 times the number of persons on board

8. Your vessel is crossing a river on the Great Lakes System. A power-driven vessel is ascending the river, crossing your course from port to starboard. Which statement is TRUE?

A. The vessel ascending the river has the right of way.
B. Your vessel has the right of way, but you are directed not to impede the other vessel.
C. The other vessel must hold as necessary to allow you to pass.
D. You are required to propose the manner of passage.

9. A shipper of cargo aboard your vessel offers a letter of indemnity for the cargo. This is done in order to obtain a(n) _____.

A. Clean Bill of Lading
B. Order Bill of Lading
C. Straight Bill of Lading
D. Through Bill of Lading

10. What is NOT surveyed at an annual load line survey?

A. The overall structure and layout of the vessel for alterations to the superstructure
B. The bilge pumping system
C. Main deck hatch covers
D. Portholes and deadlights in the side plating

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

Nautical Queries

Engineering Questions

1. A controllable pitch propeller on a diesel driven vessel eliminates the need for _____.

A. friction clutches
B. disconnect clutches
C. reversing gears
D. reduction gears

2. If the centrifugal switch or relay used for cutting out the starting winding of a split-phase induction motor fails to open once the motor is in operation, the _____.

A. motor will overspeed
B. starting winding will burn out
C. motor will immediately stall under load
D. motor torque will be above normal at rated speed

3. When any low pressure distilling plant is operated with less than the designed vacuum, the _____.

A. heat level rises
B. heat level drops
C. capacity increases
D. scale formation decreases

4. A pressure-velocity compounded impulse turbine consists of _____.

A. velocity compounding with reaction pressure compounding
B. several rows of moving blades attached to diaphragms
C. two or more stages of velocity compounding
D. two or more rows of nozzles in which no pressure drop exists

5. Which of the following conditions could cause the feed pump for an auxiliary boiler to lose suction?

A. Increased suction head pressure
B. Decreased feedwater temperature
C. Pump recirculating line being open too much
D. Excessive feedwater temperature

6. A low velocity fog applicator is used in firefighting to _____.

A. apply large droplets of foam
B. cool and smother the fire
C. break up burning embers
D. extinguish hard-to-reach electrical fires

7. In a diesel engine, the main bearings are used between the _____.

A. connecting rod and the crankshaft
B. wrist pin and connecting rod
C. camshaft and the engine block
D. crankshaft and the engine block

8. Steam supplied to the main propulsion turbines is _____.

A. saturated steam
B. superheated steam
C. desuperheated steam
D. wet steam

9. Why are heavy fuels not usually prone to the problems of microbiological infection?

A. Heavy fuels are subjected to better refining processes, which prevent the formation of these growths.
B. Most heavy fuels contain chemicals which prevent the growth of fungi and other bacteria.
C. Microbiological infection does not affect marine fuel but rather the personnel who are involved with the handling, storage, and purification of the fuel.
D. The necessary nutrients that organisms feed on are in a more complex form and not available for microbial degradation.

10. The greatest single overall steam plant boiler efficiency loss results from _____.

A. heat loss in the main condenser
B. poor heat transfer in the feedwater heaters
C. mechanical losses in the atomization process
D. permanent poor combustion in the boiler

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