



CREW ENDURANCE MANAGEMENT

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Crew Endurance Resources

Welcome to *Crew Endurance Management* newsletter, bringing you the latest information about sleep and endurance. Our goal is to support your personal knowledge and application of the principles of crew endurance management.

Navigation and Vessel Inspection Circular (NVIC) 02-08, dated March 21, 2008, provides guidelines for vessel owners, operators, third-party auditors, Coast Guard personnel and others to assess a company's or vessel's CEMS program. Enclosures in the NVIC provide a discussion of the essential implementation steps, risk factors, and the role of the CEMS Coach. Lastly there is a job aid/checklist provided to aid an evaluator in assessing an organization's CEMS program: <http://www.uscg.mil/hq/cg5/nvic/>

To receive *Crew Endurance Management* by email, please register with us: <http://www.uscg.mil/hq/cg5/cg5211/cems.asp>

SITUATIONAL AWARENESS

What is it?

*Dr. Carlos Comperatore
and Captain William
Abernathy*

Situational awareness refers to the capability to maintain a constant vigil over important information, understand the relationship among the various pieces of information monitored, and project this understanding into the near future to make critical decisions. In many ways the term "Situational Awareness" is, in reality, a form of mental bookkeeping.



Crewmembers aboard towing vessels, whether working on the navigation watch, on deck, in engineering, or in the galley, must constantly maintain situational awareness to ensure safe operations. A healthy dose of situational awareness is essential to make informed decisions, act in a timely manner, and ultimately ensure operational safety, whether at sea or transiting through inland waterways, harbors, or coastal environments. Maintaining 24-hour vessel operations while successfully meeting navigational challenges such as inclement weather, vessel traffic, bridges, locks, and recreational vessels, among others, requires all of the cognitive processes supporting situational awareness in good working order.

Studies of accidents in maritime operations support the notion that loss of situational awareness plays a significant role in incidents attributed to human error. Analysis of towing vessel accidents revealed that human factors accounted for 54% of the medium and high severity incidents and about 40% of the low severity incidents. Failures in situational awareness or task performance accounted for 69% of the medium and high severity human factors incidents. A separate study, examining 459 bridge allisions, reported that 78% of the incidents were associated to human error and 12 % to other operational errors. Only 5% of the cases were attributed to mechanical problems, and the remaining 5% were not resolved due to insufficient information. Of even greater importance is the finding that critical decision-making errors contributed to 68% of 435 cases involving performance failures.

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Considering the notions presented here, we propose that in rapidly changing operational scenarios, as is the case with the many segments of the maritime transportation industry, failures to maintain situational awareness can lead to inadequate decision making and ultimately operator performance errors. In this newsletter issue, we offer evidence derived from research efforts and accident investigations, establishing the association among degraded human endurance, loss of situational awareness, and accidents. We hope that this information helps CEMS practitioners and interested readers in the constant effort to manage misinformation, while protecting crewmember health and performance. 



Threats to Situational Awareness

An Interview with Captain Mike Sanders

Dr. Carlos Comperatore and Pik Kwan Rivera

Mike Sanders was one of the first line towing Captains to fully implement CEMS (including schedule changes) on his boat. Captain Sanders continues to be employed with ACL.

The following excerpts from an interview with Captain Mike Sanders reveal the many threats to situational awareness that exist in towing operations. We look forward to hearing comments and feedback from readers on this article.

Newsletter: Captain Sanders, thank you for graciously agreeing to talk to us about situational awareness (SA). We would like to start by asking you to define SA in your own words, and give us an idea of which operational conditions may threaten SA while a person is on watch.

Captain Sanders: Situational awareness develops from moment to moment—it is critical to safe navigation. It takes every ounce of mental energy to focus on issues like traffic patterns, river dynamics, weather, obstacles to safe navigation, ongoing tow work, not to mention navigational challenges like bridges, locks, and turns. However, administrative duties can also threaten situational awareness. Let me explain.

Towing vessel captains take care of the navigation watch for 12 hours per day. During this watch, they must also manage administrative duties. In our operational environment, a brief mental distraction can have delayed consequences half a mile later. During the daytime navigation watch, which usually runs from 0600-1200, juggling

inspection reports, logs, daily paperwork, fleet arrival schedules, travel information, and boat store calls—along with navigation duties—simply creates a very high mental workload.

Newsletter: Are there any other threats to SA?

Captain Sanders: Yes, particularly during the evening watch. If you are transiting through very familiar waterways, your mental workload may be light. This time can be dangerous because situational awareness may become significantly reduced unless you take proactive measures. I try to stay mentally active and in constant communication with other crewmembers. I strongly believe that crewmembers should communicate regularly with the captain, particularly late at night between 2000 and 0000. This is the very bottom of the watch, and fatigue may be setting in. This is not a good time to relax. To stay alert, it's best to limit your communication with other crewmembers and people on shore. If you engage in conversations that are not related to vessel navigation, you can become distracted, and impair your situational awareness.

Newsletter: Other than getting adequate rest every day of the trip, can you suggest other practices to help you maintain and protect situational awareness?

Captain Sanders: I would like to mention another method to promote situational awareness. Before you arrive on a vessel for a new assignment, you should become familiar with issues like changes in company operational policies, waterways in the upcoming trip, any reported obstacles and threats to navigation, and ATON failures. This allows you to mentally prepare for what is going on, rather than having to waste time catching up. In my opinion, the first navigation watch is no time to play catch-up. 



Case Reviews: Towing Casualties Attributed to Lack of Situational Awareness

Captain William Abernathy

Here are abstracts from five casualties in the U.S. towing industry that can be attributed to a loss of situational awareness (SA). These cases were reviewed by both Coast Guard and the American Bureau of Shipping (ABS). Please note that in each of these case summaries, situational awareness was not lost because of fatigue or low endurance, but by other factors that may cause distraction or create impairment.

▶ At the change of a watch, the master asked the helmsman (who had the conn) to look on the chart for a certain object. Very shortly thereafter, the tow ran aground, holing two barges and spilling 1800 barrels of gasoline into the river. The helmsman was charged with the grounding. He had lost his situational awareness for several reasons. First, the he was not familiar with that portion of the river and had asked the captain to remain in the wheelhouse. Second, two downbound tows had passed his tow, causing it to be out of the navigable portion of the river. Finally, the captain asked the helmsman to examine a chart, thereby taking the helmsman's attention away from conning.

If the captain, who had local knowledge, had taken the conn until the tow was maneuvered back into the normal channel, this grounding might have been avoided.

▶ While maneuvering to avoid two downbound tows, the captain of an upbound tow ran aground, spilling a significant amount of oil. Although several shore-based navigation lights effectively marked the danger ground, the captain admitted to navigating by merely counting buoys. This practice (counting buoys) is imprudent as a sole method of navigation, because buoys often come off station.

The combination of not using all available navigation aids and the downbound tows caused a loss of SA.



▶ While entering the VTS in the San Juan Islands, the captain of a tug and tow failed to put regular position fixes on the local chart. He also failed to erase the last courses used on the chart. Instead, he chose to rely on radar and his local knowledge. A 'rogue' current set the tow out of deep water toward a series of reefs. Once he was aground, the Captain had no idea where he was!

If he had followed normal, established procedures of navigation, the captain would have had the situation awareness he needed to keep his tow out of harm's way.

▶ A tow being pushed ahead by a towboat on a river overran over a recreational boat. The towboat master claimed that the recreational boat 'dashed' in front of his tow, but other witnesses stated that the recreational boat was dead in the water when the tow ran over it. Investigators found that the empty barges at the head of the tow limited visibility from the towboat wheelhouse.

If the tow captain had kept a lookout at the head of the tow, his situational awareness would have been better, and two lives might not have been lost.

▶ A few minutes after clearing his tow through a bridge opening, a towboat captain collided with a recreational fishing vessel, killing one person on the fishing boat. The fishing vessel had been part of a fleet. The tow was at full speed ahead and gave incorrect sound signals to the fleet of fishing vessels. Furthermore, the captain had dismissed a lookout at the head of the tow immediately after the bridge was cleared.

Someone died, in part because the captain dismissed his lookout and let his guard down after clearing the bridge. If the lookout had been kept at the head of the tow, it could have helped the captain maintain situational awareness and take earlier action to avoid the collision. Of course, inaction by the fishing boat was also a contributing factor in the collision. ⚓



Managing Misinformation in CEMS

Effects of Sleep Restriction on Human Performance

Pik Kwan Rivera

When professional mariners receive training on Crew Endurance Management System (CEMS), they are reminded to manage 'misinformation.' This article will show the CEMS educator how to manage misinformation about the effects of restricted sleep on human endurance.

Industry/company representatives and crewmembers often argue that their personnel can get used to sleeping less than seven continuous hours per day without any adverse impact on their health, endurance, and cognitive abilities. This opinion has no basis in fact.

In 2002, researchers at the Walter Reed Army Institute of Research in Silver Spring, MD, published a paper that examined performance degradation and restoration in 66 research volunteers. To establish a base line, the participants were allowed 8 hours of continuous time in bed (TIB) after



which their performance was measured. Then, the volunteers were allowed three, five, seven, and nine hours of continuous TIB, each night for seven consecutive days. Participants who had nine consecutive hours TIB each night showed no performance impairment. By contrast, participants who had five or seven hours of TIB showed slower reaction speeds, with the five-hour TIB participants becoming significantly less alert. The performance and alertness levels of participants who were allowed only three hours TIB decreased dramatically over the seven-day period.

This study also highlighted the importance of recovery sleep on performance. After the seven days of sleep restriction, participants were allowed eight consecutive hours of TIB for three days. During this three-day recovery period, participants underwent neurobehavioral tests while awake. The nine-hour TIB group showed no significant differences from the baseline. By contrast, the three-hour TIB group rapidly recovered when allowed eight hours

Figure 1

WALTER REED ARMY INSTITUTE OF RESEARCH – BELENKY, et al (2002)		
TIME-IN-BED RESTRICTION EXPERIMENTAL CONDITION	7 DAY RESTRICTION PERFORMANCE	3 DAY POST-RESTRICTION RECOVERY CONDITION
3 HOURS	Consistent degradation of speed and alertness across 7 days.	Rapid improvement during first night of recovery. Recovery incomplete as performance stabilizes to levels similar to those exhibited by participants in the 5 or 7 hour sleep restricted condition.
5 HOURS	Increase of degraded reaction speed and alertness across 7 days.	Recovery is incomplete. Performance in both speed and alertness improved, but settles to compromised levels. This group needs more than three days of recovery time.
7 HOURS	Increase in degradation of reaction speed across 7 days.	Performance in both speed and alertness improves, but still below baseline levels. This group also needs more than three days of recovery time.
9 HOURS	No degradation compared to baseline.	No degradation compared to baseline.

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of TIB on the first night, though their performance did not recover to baseline level (eight-hour TIB). In fact, during the three days of sleep recovery, this group's performance levels never rose higher than those of participants whose sleep had been restricted to five or seven hours.

This research showed that people who are deprived of sleep need more than three days to recover in order to return to their baseline performance level. Although no one who had less than eight continuous hours of TIB reported feeling sleepy, this group's performance and alertness levels decreased significantly, especially in the five-hour and three-hour TIB groups. This shows that sleep-deprived people do not realize their own performance is impaired.

In a more recent study, Van Dongen and co-workers observed 48 healthy adults whose sleep was restricted to four, six, and eight hours of TIB per night for 14 days. While awake, participants underwent neurobehavioral tests every two hours to determine the effects sleep restriction had on their daytime performance. These tests included a Psychomotor Vigilance Task to measure attention/reaction time, a computerized digit-symbol subtraction task to measure working memory, a serial addition/subtraction task to test for mental agility, and a subjective sleepiness scale rating. Taken together, the tests measured participants' cognitive abilities while they performed tasks requiring vigilance and mental tracking of critical information. Results showed that, as sleep loss accumulated over the 14 days, neurobehavioral performance deteriorated.

Remarkably, the performance levels of participants who were allowed less than 6 hours of TIB per day for 14 days degraded as much as those of participants who had no TIB for up to two days. Paradoxically, none of the sleep-restricted participants reported feeling sleepy.

The results of both studies are important to towing operations. Crewmembers often get less than seven hours of uninterrupted sleep per day during extended voyages, and have little or no opportunity to recover (i.e., eight hours TIB). When given less than eight hours TIB per night for long stretches, a crewmember's alertness and cognitive ability will decline. Often crewmembers often do not report feeling sleepy, even though their cognitive abilities are impaired.

It should be noted that participants in these studies were adapted to a daytime work schedule (i.e., awake during the day and asleep during the night.). Performance and cognitive impairment are even worse in crewmembers who work at night and sleep during the day (e.g., after-watch personnel). This is caused by biological clock issues and chronic sleep restriction. Other factors—such as travel time to the vessel and personal habits, such as drinking alcohol—can make things worse.

For CEMS coaches and experts, managing misinformation is an important responsibility. These studies clearly show that sleep restriction affects alertness and job performance, even though crewmembers may report that they feel just fine. 🚢

Figure 2

TIME-IN-BED RESTRICTION EXPERIMENTAL CONDITION	14 DAY DEPRIVATION PERFORMANCE
0 HOURS	Rapid and consistent degradation of cognitive alertness throughout the 72 hours with no sleep.
4 HOURS	Steady performance degradation throughout the 14 days with levels comparable to those experienced by participants exposed to 3 days without sleep in the last three days of the study period.
6 HOURS	Steady performance degradation throughout the 14 days with levels comparable to 2 days without sleep in the last 5 days of the study period.
8 HOURS	No significant performance degradation compared with baseline data.



Risk-Based Decision Making: A Good Strategy



Captain William Abernathy

We all make risk based decisions every day, both on and off the job. For example: Should I change lanes on the interstate? Should I meet the next tow on one whistle or two? These are

informal decisions, which are usually intuitive, involve common sense, and don't require a formal analysis process. However, other decisions *may* need more formal analysis. For example: How much insurance should I get to protect my family? Where can an unexpected machinery failure be repaired, and how will it get funded?

What about changing river conditions? Does your company have a process whereby boats may determine safe movement in the pools and through the locks? Does your company impose draft restrictions on boats and barges before the Coast Guard and Army Corps of Engineers? Does your company address endurance risks and Situational Awareness issues?

Is RBDM For Me?

Risk-based decision making (RBDM) is for everyone. Even an inexperienced person trained to use a well-developed risk-based checklist will make good risk-based decisions.

Let's say you are sold on the risk decision making process as a resource, and you want to use it to identify, minimize, or eliminate risks. You also want to tap the huge base of practical experience coming from the deck plates of your towboats. How do you find out more? Why, you 'Google' it, of course! But unfortunately, when you key in risk, risk prevention, or risk based decision-making, Google will connect you to some really fancy sites that are not at all related to the marine industry.

Drilling down into the search engines only yields more frustration. You aren't interested in liquidity on Wall Street; you want to find out more about operating safely on the waterways!

Fortunately, there is help. Several years back, the Coast Guard and the Passenger Vessel Association collaborated on a booklet entitled "PVA Risk Guide." Shortly afterward, the Coast Guard and the Chemical Transportation Advisory Committee (CTAC) collaborated on "Marine Operations Risk Guide" (MORG).

Great, you say—but I don't carry any passengers. My barge cargo is grain and gravel, not chemicals. No problem. A closer examination will show you that the PVA members and chemical transporters, for the most part,

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operate in the same environment and deal with the same issues your fleet encounters. Those ferry boats crossing in front of your tow? They're members of PVA. Those red flag barges heading upstream? They carry chemicals. You may not be in the same boat as they are, but you are certainly on the same waterway.

These two guides provide a practical ten-step process to practice risk assessment, risk management, and risk communication. They present case studies, based on real companies looking at real problems on and around their vessels, to walk you through the ten-step process. Even better, they include a work sheet that can be easily modified to match your company's unique operations. These guides show how you can profit by mitigating risks.

As stated in both guides: "This guide is intended to provide the mariner and operator with a tool for identifying opportunities to reduce risk exposure. This guide is not intended to provide the Coast Guard with a means to regulate at the port level."

Both guides can be downloaded in a PDF format from the Coast Guard, PVA, or CTAC websites shown at right. 

PDF: PVA Risk Guide

File Format: PDF/Adobe Acrobat

The PVA Risk Guide is an effective tool that should be used as often as necessary to determine the severity and likelihood of particular operational risks:

www.uscg.mil/hq/cg5/cg5211/docs/pvarisk_guide.pdf

PDF: Marine Operations Risk Guide

File Format: PDF/Adobe Acrobat.

Risk Guide. A Guide to Improving Marine Operations by Addressing Risk. PVA Risk Guide and the Marine Operations Risk Guide: www.uscg.mil/hq/cg5/cg5211/docs/morg.pdf





CEMS Resources

This August, when you access any Coast Guard website, you may notice significant change. All of the Coast Guard websites have been “rebranded.” Across the top of each page will be the Coast Guard banner and access buttons to get you quickly to other sites. The left, gray column will show the security status promulgated by the Department of Homeland Security. It contains local hyperlinks to help you navigate through specific webpages.

Normally, our newsletter would provide convenient hyperlinks to move you to Coast Guard, and other websites. With the rebrand date occurring so close to press time, to avoid confusion we felt it best to eliminate the hyperlinks for this issue. However, you can find the CEMS Website and Membership Information at this new location:

<http://www.uscg.mil/hq/cg5/cg5211/cems.asp>

Upcoming Coaches Classes

Northeast Maritime Institute

Fairhaven, MA

August 12-13, September 10-11, October 7-8, November 4-5, and December 9-10, 2008.

Contact Captain Robert Glover:

Email: rglover@northeastmaritime.com

Phone: 508.992.4025

Salyers Solutions

August 12-13, Jacksonville, FL

August 27-28, Lake Charles, LA

September 3-4, Seattle, WA

September 10-11, Anchorage, AK

Contact Jo Ann Salyers:

Email: salyers_solutions@hughes.net

Kirby Corporation

Kirby Corporation has the following coaches training dates:

August 7-8, September 4-5, October 2-3, November 13-14, and December 18-19. Most training will take place at Kirby Houston offices (call ahead).

Contact Ms. Kelly Parker:

kelly.parker@kirbycorp.com

713.435.1775

Inland Waterways Academy

Huntington, WV

Contact: Captain John Whiteley

or Jo Ann Salyers

Email: whiteley@marshall.edu

Phone: 304.697.5616

Email: salyers_solutions@hughes.net

Phone 504.236.4962

Upcoming Experts Training Classes

An Experts Class will be held in the winter of 2009.

Contact LCDR Vivianne Louie for details.

CEMS Training Update

Currently, there are over 2250 trained coaches in the commercial maritime industry.

The list below highlights the 10 companies with the most trained coaches:

Company Coaches

Kirby

AEP

Ingram

ACBL/ACL

ARTCO

TECO Barge

Canal Barge Co.

Washington State Ferries

Penn Maritime

Luhr Brothers Towing

Trained Experts

Government	8
Maritime academies	4
Operating companies	26
Consultant/contractors	5
Training institutions	4

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