

Collision Between U.S. Coast Guard Vessel *CG 33118* and
Sea Ray Recreational Vessel *CF 2607 PZ*
San Diego Bay, California
December 20, 2009



Accident Report

NTSB/MAR-11/03
PB2011-916403



**National
Transportation
Safety Board**

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Marine Accident Report

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and Sea Ray Recreational Vessel *CF 2607 PZ*
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**National
Transportation
Safety Board**

490 L'Enfant Plaza, SW
Washington, DC 20594

National Transportation Safety Board. 2011. *Collision Between U.S. Coast Guard Vessel CG 33118 and Sea Ray Recreational Vessel CF 2607 PZ, San Diego Bay, California, December 20, 2009. Marine Accident Report NTSB/MAR-11/03. Washington, DC.*

Abstract: This report discusses the December 20, 2009, collision on San Diego Bay, California, between the 33-foot-long U.S. Coast Guard special purpose craft – law enforcement (SPC-LE) *CG 33118* and an unnamed 24-foot-long Sea Ray recreational boat with California registration CF 2607 PZ. As a result of the accident, an 8-year-old passenger on board the Sea Ray died. Safety issues identified in this accident include the speed of the *CG 33118*, Coast Guard oversight of small boat operations, SPC-LE forward visibility, Coast Guard monitoring of small boat operational data, and Coast Guard use of personal cell phones while under way. On the basis of its findings, the NTSB made recommendations to the Coast Guard.

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Acronyms and Abbreviations

ABYC	American Boat and Yacht Council
AIS	automatic identification system
AOR	area of responsibility
BCEB	boat crew examination board
CBL	cutter boat large
CPR	cardiopulmonary resuscitation
DGPS	differential global positioning system
DHS	U.S. Department of Homeland Security
FAA	Federal Aviation Administration
GAR	green-amber-red (risk assessment)
HF-SSB	high frequency-single sideband
IAP	incident action plan
ISO	International Organization for Standardization
JHOC	Joint Harbor Operations Center
MAIT	Multidisciplinary Accident Investigation Team
MARB	marine assistance radio broadcast
MISLE	Marine Information for Safety and Law Enforcement
nm	nautical mile
OIC/OINC	officer-in-charge
RBS	response boat small
RFO	Ready for Operations
SINS	scalable integrated navigation system
SDHP	San Diego Harbor Police
SPC-LE	special purpose craft – law enforcement
STAN	Coast Guard Standardization
TCT	team coordination training
UCSD	University of California San Diego
USCG	U.S. Coast Guard
UHF	ultra high frequency

UTB utility boat big
UTL utility boat light
VHF very high frequency

Executive Summary

On Sunday, December 20, 2009, about 1744 Pacific standard time,¹ the 33-foot-long Coast Guard vessel *CG 33118*, designated by the Coast Guard as a “special purpose craft – law enforcement” or SPC-LE, with five crewmembers on board, collided with a 24-foot-long Sea Ray recreational vessel with state registration number CF 2607 PZ, carrying 13 people, on San Diego Bay, California. The collision occurred during the city’s annual holiday boat parade, the Parade of Lights. The Sea Ray was headed west near the main shipping channel² to enable the occupants to watch the boat parade. The *CG 33118*, on patrol in the bay, was also headed west, its crew responding to a reported grounding. The *CG 33118* struck and overran the Sea Ray’s stern near the west end of Harbor Island. As a result of the collision, an 8-year-old boy on board the Sea Ray was fatally injured and four other people on board sustained serious injuries. No *CG 33118* crewmembers were injured in the accident.

Following the collision, drug and alcohol testing was performed on *CG 33118* crewmembers, and all results were negative. The Sea Ray operator voluntarily submitted to drug and alcohol testing, and the results of his tests were negative as well.

The National Transportation Safety Board determines that the probable cause of the collision between the *CG 33118* and the Sea Ray was the failure of the *CG 33118* crew to see and avoid the Sea Ray because of the excessive speed at which the coxswain operated the *CG 33118*, given the prevailing darkness, background lighting, and high vessel density, and the U.S. Coast Guard’s lack of effective oversight of its small boat operations both nationally and at Coast Guard Station San Diego.

Safety issues in this accident include the speed of the *CG 33118*, Coast Guard oversight of small boat operations, Coast Guard monitoring of small boat operational data, SPC-LE forward visibility, and Coast Guard use of personal cell phones while under way. As a result of this investigation, the NTSB makes recommendations to the Coast Guard.

¹ Unless noted otherwise, all times in this report are Pacific standard time (universal time coordinated –8 [UTC-8]) based on the 24-hour clock.

² The main shipping channel runs roughly east-west and is marked by lighted red and green buoys.

1 Factual Information

1.1 Parade of Lights

Each December, the on-water holiday event Parade of Lights takes place on San Diego Bay. The event attracts hundreds of boaters who watch the festivities from their vessels, ranging from small dinghies, kayaks, and canoes to large yachts and commercial vessels. Vessel traffic during the Parade of Lights is typically higher than on almost any other night on San Diego Bay, except perhaps July 4th. The Parade of Lights is held on successive Sunday nights, and the 38th annual event was scheduled for December 13 and 20, 2009. Both days' events featured a fireworks display at 1730 followed by a parade of more than 80 decorated boats on San Diego Bay. The event organizer had obtained a marine event permit, issued by the U.S. Coast Guard Sector San Diego, which authorized the festivities.³ In addition to the boats participating in the parade, organizers estimated an additional 100 spectator vessels. The Coast Guard's captain of the port for San Diego issued a notice of enforcement for a "special local regulation"⁴ for the Parade of Lights.

The parade was to begin at the south end of Shelter Island on the west side of the bay, then turn northeast and east and run parallel to Harbor Island to the east side of the bay and then south along the downtown waterfront. The trackline was about 5 miles long and ran along the shores of Shelter, Harbor, and North islands (**figure 1**). A Coast Guard Local Notice to Mariners⁵ warned boaters to use "due caution" when transiting near the designated parade area.

³ Sector San Diego has authority, including captain of the port authority, for safety within the southern California coast that includes San Diego Bay (33 *Code of Federal Regulations* [CFR] 3.55-15). Several Coast Guard stations, including Station San Diego, are responsible to Sector San Diego for certain duties, including operation of small boats. Coast Guard small boats are vessels less than 65 feet in length.

⁴ The special local regulation area for the parade included most of San Diego Bay. The notice contained no spectator craft viewing areas or operating restrictions other than to not impede the parade.

⁵ A Local Notice to Mariners may be issued to specify a temporary safety zone for marine events and other on-water operations for safety or environmental purposes.



Figure 1. Aerial photo of San Diego Bay. The yellow line shows the Parade of Lights trackline.

The Coast Guard established an incident action plan (IAP) for the Parade of Lights, which stated in part that Coast Guard vessels assigned to the event would “provide for an overt and aggressive waterborne presence” between 1730 and 2000 on both days of the parade. This was to keep boaters clear of the fireworks barge and to avoid their interfering with the lighted boats in the parade. Several Coast Guard Auxiliary⁶ vessels also were assigned to assist in the event. The 87-foot-long Coast Guard cutter *Haddock* was the first vessel in the parade. San Diego Harbor Police (SDHP), which normally had two vessels patrolling the bay at all times, had four boats on patrol that night. The SDHP and the Coast Guard shared law enforcement activities on San Diego Bay. The IAP also stated that any injuries were to be reported to the Joint Harbor Operations Center (JHOC).⁷

1.2 Accident Narrative

1.2.1 Sea Ray

About 1715, the 24-foot-long Sea Ray recreational boat (**figure 2**) left its berth at the Harbor West Marina located at the west end of Harbor Island. On board were three families: the operator, his wife, and three children; and two other couples with two children each. In total, 13 people were on board. After departing the marina, the Sea Ray operator proceeded along Harbor

⁶ The Coast Guard Auxiliary is an incorporated civilian volunteer component of the U.S. Coast Guard.

⁷ The JHOC is a command and control facility staffed by contingents of the Coast Guard, U.S. Navy, San Diego Harbor Police, and, on occasion, other Federal, state, and local government agencies. The JHOC communicates with and coordinates government vessel operations on San Diego Bay.

Island's south shore toward the east end of the island. There, he stopped the boat to watch the fireworks, which were scheduled to begin at 1730.



Figure 2. A 24-foot-long Sea Ray recreational boat similar to the one involved in the accident. Photo by Sea Ray, Inc.

After the fireworks display ended, the Sea Ray operator headed west in the bay at idle speed (about 2–4 knots) toward the west end of Harbor Island to position the vessel for viewing the boat parade. According to a passenger, the families decided that, because several young children were on board and because it was a Sunday night with school the next day, they would position themselves close to the Harbor West Marina, thus shortening the time needed to return and dock the boat after the parade.

Both the Sea Ray operator and a passenger told NTSB investigators that the boat's navigation lights, including the port and starboard running lights and the all-around light, were illuminated. The operator, SDHP officers, and other witnesses confirmed that all the children on board were wearing lifejackets.⁸

The Sea Ray operator said that when he was about three-quarters of the way to the west end of Harbor Island he heard what sounded like an engine running at high speed behind him. He estimated that about 20 other boats were within 50 yards of his location, primarily to the north, and that the other boats were drifting, idling, or at anchor. On hearing the engine sound, he looked back over his shoulder and noted that the engine sound seemed to be coming closer and that the vessel that was producing the sound had not appreciably changed course. The Sea Ray operator told investigators that, shortly before the collision, he saw the approaching vessel with red and green running lights illuminated and three people silhouetted in the pilothouse. The

⁸ California state boating law requires that all children 11 years of age or younger wear a Type I, II, III, or V Coast Guard-approved lifejacket while on board a vessel that is 26 feet or less in length while the vessel is under way (<<http://www.dbw.ca.gov/Pubs/Pfd/PFDs.pdf>> accessed January 4, 2011). According to San Diego Harbor Police, the Sea Ray also carried lifejackets for all persons on board, as required by law.

Sea Ray operator told investigators that he saw that the approaching vessel's hull was "on the plane,"⁹ and that the vessel was "dead center" off his stern. He said that he thought he needed to move his boat out of the way to avoid being struck by the oncoming vessel. He "slammed" the throttle forward and turned to starboard, but as he was starting to make the starboard turn, the oncoming vessel struck the Sea Ray's stern. The Sea Ray operator told investigators that there was no time for his boat to reach any kind of speed between the time that he accelerated and the collision. He said that his boat "did not move more than five feet, if that," and that the other vessel was closing in "very rapidly, like almost at us and then maybe a second passed and then it hit us. It was just very fast." The Sea Ray operator said that the colliding vessel had "such high speed ... it literally [shot] right over the top of us."

1.2.2 CG 33118

The *CG 33118* (**figure 3**), which the Coast Guard designates a "special purpose craft – law enforcement" or SPC-LE, and its crew were not assigned to the Parade of Lights. The IAP for the event stated that the patrol commander could call on a station asset (such as the *CG 33118*) to support law enforcement activity; however, one was not requested.



Figure 3. SPC-LE CG 33118. Photo by the Coast Guard.

⁹ Planing occurs when a boat's speed and hull shape generate sufficient lift to support a portion of the craft above the water. See section "Vessel Forward Visibility" for more detail.

Although Sector San Diego did not request a station asset to assist in the event, Station San Diego's operations petty officer scheduled a patrol that evening. About 1645, the five *CG 33118* crewmembers met for a briefing before their anticipated 1700 departure and patrol. The boat crew included the coxswain,¹⁰ a second qualified boat crewmember, the boat's engineer, a crewmember-in-training, and Station San Diego's officer of the day (OOD),¹¹ who had elected to join the patrol. (For more information on the crew, see section "Personnel Information.") The crewmember-in-training told NTSB investigators that the coxswain led the meeting and informed the crewmembers that they might be on patrol for 3 or 4 hours. He said that although they were not officially assigned to the Parade of Lights, their stated purpose was "just going out, making sure everything's good, making sure there's no DUIs, making sure—just having an asset in the area for...general safety overall." The boat engineer told NTSB investigators that the station's "boat assignment board" assigned the *CG 33118* a patrol mission to assist the *Haddock* that night. The boat engineer told NTSB investigators that a crew meeting was held before getting under way and that it included a green-amber-red (GAR) risk assessment¹² for that mission. He said that the results of the GAR were "green" (also see section on Management/Coast Guard Operational Information, Crew Brief).

At 1723, the *CG 33118* crew notified the JHOC of its departure from Station San Diego. When the fireworks display began at 1730, the crew stopped the vessel to watch. When the display ended about 5 minutes later, the *CG 33118* proceeded toward Shelter Island on the west side of the bay where the boat parade was to start. When the *CG 33118* reached that location, the crewmembers radioed the *Haddock's* crew, stating that they had no specific assignment related to the parade but would be nearby and could provide assistance if requested. **Figure 4** shows the approximate route of the *CG 33118* across San Diego Bay.

¹⁰ The Coast Guard assigned coxswains the responsibility for, in order of priority, the safety and conduct of passengers and crew, safe operations and navigation of the boat, and completion of the mission. Coxswains were also to respond to hazards to life and property, violations of laws or regulations, and discrepancies to aids to navigation.

¹¹ At Coast Guard stations, the OOD is the direct representative of the station's officer in charge, and ensures compliance with the station's regulations and policies. Except for the executive petty officer and the engineering petty officer, all personnel at the station are subordinate to the OOD. Normally, the officer in charge assigns the senior coxswain in the duty section as OOD to oversee security, order, and supervision of personnel. Nonetheless, while underway the OOD's status is no different than that of the other crewmembers in being subordinate to the coxswain.

¹² The GAR safety risk assessment determines whether a mission should be deemed green (0–22 points, low risk), amber (23–43, medium risk, caution), or red (44–60 points, high risk).



Figure 4. The path of the CG 33118 from Station San Diego to the *Haddock*, then northeast and east across the bay, and then returning west to the accident site. Also indicated are the locations of the Coast Guard cutter *Haddock* at the time of the accident, the sailboat from which a witness filmed a video that the NTSB later used for video and sound analysis, and the Hilton Hotel from which witness photographs were taken of the accident scene.

According to the crewmember-in-training, a few minutes after communicating with the *Haddock*, the CG 33118 crew heard a marine assistance radio broadcast (MARB),¹³ transmitted by the JHOC,¹⁴ that stated that a 25-foot Catalina sailboat was aground. The Catalina operator advised the JHOC that he and his passengers were not in distress and that he was going to wait for high tide to refloat his vessel. The MARB provided the sailboat's estimated coordinates, and added that the vessel was located "within view" of the Sheraton Hotel on Harbor Island. The MARB included a request for other boaters or a private towing company to assist. On hearing the MARB, the CG 33118 crew radioed the JHOC and asked for permission to respond to the call.¹⁵ The JHOC watchstander told NTSB investigators that he granted the permission, and that he informed the CG 33118 crew that the grounded vessel, "wasn't in any immediate danger, wasn't

¹³ According to Commandant Instruction M16130.2E, National Search and Rescue Supplement, a MARB is made to solicit voluntary response from anyone who can assist the mariner. If the Coast Guard does not receive a response to the MARB within a reasonable period of time, typically 10 minutes, Coast Guard resources and/or auxiliary vessels may be directed to respond.

¹⁴ The JHOC transmitted the MARB at 1738. However, because the Catalina was not equipped with a GPS, JHOC personnel had to estimate its position coordinates for the MARB.

¹⁵ According to Coast Guard search-and-rescue operating procedures, a small boat such as the CG 33118 must have the sector's permission to respond to a search-and-rescue situation.

taking on water, and that we weren't asking them or tasking them to go there." The *CG 33118* crew then headed east to look for the sailboat along the south shore of Harbor Island. However, the sailboat was actually on the north side of Harbor Island, in the West Basin.¹⁶ When the *CG 33118* crewmembers could not locate the sailboat, they radioed the JHOC for clarification. The information was corrected, and, according to the crewmember-in-training, the coxswain turned the *CG 33118* around and headed west toward the West Basin inlet.

The crewmember-in-training told NTSB investigators that, leading up to the collision, he was not paying attention to the speed of the vessel. He said that the engine sound seemed commensurate with traveling about 20–25 knots. Neither the crewmember-in-training nor the boat engineer recalled hearing any crewmember voice concern about the speed of the *CG 33118*. Both of them told investigators that the radar on board the *CG 33118* was operating. The boat engineer told investigators that, just before the *CG 33118* impacted the *Sea Ray*, he heard one of the crewmembers shout "oh god."

Following the accident, the *CG 33118* coxswain told SDHP that, at the time of the collision, he was proceeding at about 3000 rpm¹⁷ about 200–300 yards south of Harbor Island, close to the main shipping channel. He stated that, as the *CG 33118* was en route, it suddenly "shot straight up in the air." He told police, "I knew I hit a boat," and that he had not seen it. The coxswain stated that when he "landed" he turned the *CG 33118* around and came alongside the boat. He then handed the controls to the OOD. The coxswain declined to be interviewed by NTSB investigators.

1.2.3 Witness Reports

Witnesses interviewed after the accident indicated that the *CG 33118* was moving at a higher speed than other vessels in the area that night, and that the speed was about the same on both the eastbound and westbound legs. They also indicated that the vessel was on a plane both before and during the accident leg. The witnesses stated that the *CG 33118* approached the slower-moving boat from astern. Witnesses (including boat crew) reported that the sound of the engine pitch did not decrease before the collision.

A recreational boater witnessed the sequence of events from an estimated 70-yard distance. He told investigators that he saw blue flashing lights on top of a fast-moving vessel (he estimated a speed of about 25 knots) headed west toward his location. As the vessel approached, he could see that it had an orange hull with a high aluminum cab. He did not hear a siren nor see the vessel slow down before it collided with the stern of a smaller boat, which had its running lights on and was also traveling to the west. When the faster vessel struck the smaller boat, the stern of the smaller boat moved down and the bow of the faster vessel was projected up and momentarily into the air above the other boat. The witness said that he could see some of the occupants on the smaller boat and that they seemed to be ducking as the faster vessel came over the top of their boat. The faster vessel landed on the smaller boat, rolled off its port side onto the

¹⁶ The West Basin is a protected area north of Harbor Island, primarily containing marinas and recreational boat slips.

¹⁷ About 19 knots on SPC-LE vessels.

water, and then continued to “coast” toward the west. The smaller boat righted itself and remained afloat but was rotating in a clockwise rotation. The noise of the collision alerted boaters in the immediate area, and some began directing their spotlights in that direction.

Another witness, a guest at the Hilton hotel located on the south shore of Harbor Island, observed the events from the sixth floor of the hotel, about 240 yards from the accident site. He told investigators that he saw what appeared to be a law enforcement vessel with its blue lights activated. The witness stated that the vessel first passed his location in an eastbound direction. It then stopped and was motionless for about a minute before turning and traveling back. He estimated the vessel’s speed at 25–30 knots.

A second witness on the south shore of Harbor Island told investigators that he saw a Coast Guard vessel traveling to the east and then back again to the west at high speed until it struck a boat on the starboard quarter, about 300 yards off the island. He described the Coast Guard vessel as “running flat” (that is, planing), with its bow fairly level with the water and not high in the air. A witness on Shelter Island said that the *CG 33118* was traveling at “a high rate of speed.” Another witness said that after the *CG 33118* turned around, it appeared to be traveling at a “higher rate of speed, dangerously close to the anchorage.”

According to automatic identification system¹⁸ (AIS) data obtained from Sector San Diego, the *Haddock* was southwest of the west end of Harbor Island when the accident occurred. The *Haddock*’s officer of the deck¹⁹ told NTSB investigators that he saw the *CG 33118* approach the *Sea Ray* and wondered if the Coast Guard vessel would avoid the *Sea Ray*. He estimated the *CG 33118*’s speed as 25 knots, the same speed he estimated the vessel had been traveling when it departed the *Haddock* and headed east in the bay. The *Haddock*’s commanding officer reported that the collision occurred about 100 yards off the *Haddock*’s bow. NTSB investigators determined the approximate position to be latitude 32°43’18.8” N and longitude 117°12’38.2” W.

1.3 Injuries

The injuries sustained in this accident are categorized in the table below according to the injury criteria of the International Civil Aviation Organization. The NTSB uses these injury criteria in all its accident reports, regardless of transportation mode.

¹⁸ An AIS is a maritime communications system that automatically transmits vessel information, including a vessel’s name, type, position, course, speed, navigational status, and other safety-related information, to appropriately equipped shore stations, other vessels, and aircraft. The AIS also automatically receives such information from similarly fitted vessels. Also see sections 1.15.3, Other Information, Automatic Identification System, and 2.7, AIS Use.

¹⁹ On Navy and Coast Guard vessels, the officer of the deck is the direct representative of the commanding officer and is responsible for the safe operation of the vessel.

Type of Injury	CG 33118	Sea Ray	Total
Fatal	0	1	1
Serious	0	4	4
Minor	0	6	6
None	5	2	7

Title 49 *Code of Federal Regulations* (CFR) Section 830.2 defines a fatal injury as any injury that results in death within 30 days of an accident. It defines serious injury as that which requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; results in a fracture of any bone (except simple fractures of fingers, toes, or nose); causes severe hemorrhages, nerve, muscle, or tendon damage; involves any internal organ; or involves second- or third- degree burns, or any burn affecting more than 5 percent of the body surface.

1.4 Damage

1.4.1 CG 33118

The *CG 33118* sustained minor damage. As of the date of this report, the cost of the damage to the *CG 33118* had not been determined.

1.4.2 Sea Ray

The Sea Ray was destroyed in the accident. Its value was estimated at \$30,000.

1.5 Personnel Information

1.5.1 CG 33118

Coxswain. The coxswain, age 21, was seated in the forward starboard seat, and was operating the *CG 33118* at the time of the accident. According to Coast Guard records, he obtained his qualifications as follows:

- Utility boat big (UTB) boat crewmember, October 2007
- UTB tactical crewmember, September 2008
- SPC-LE pursuit crewmember, November 2008
- SPC-LE boat crewmember, December 2008
- UTB coxswain, January 2009
- SPC-LE coxswain, February 2009
- UTB and SPC-LE tactical coxswain, June 2009
- SPC-LE pursuit coxswain, July 2009

From April to June 2007, the coxswain attended and satisfactorily completed the Coast Guard's Boatswain's mate "A" School, which included testing on navigation rules. He also completed a search-and-rescue coordination and execution course in January 2009.

The coxswain was involved in an incident about 2 months before the accident. He was on board another SPC-LE close to a concrete pier at a maintenance facility in San Diego Bay and was trying to hold the vessel's position. However, the SPC-LE and its outboard engines made contact with the pier, causing damage to the lower portion of the engines. The incident was considered minor and no action was taken against the coxswain.

Boatswain's mate third class. The boatswain's mate third class, age 24, was seated in the forward port seat at the time of the accident. According to Coast Guard training records, she obtained the following qualifications:

- Cutter boat large (CBL) crewmember, March 2009
- Utility boat light (UTL) crewmember, March 2009
- UTB and SPC-LE crewmember, October 2009

Boatswain's mate second class. The boatswain's mate second class, age 27, was Station San Diego's OOD on the day of the accident and the highest-ranked crewmember on board the *CG 33118*. He was seated in the aft port seat at the time of the accident. According to Coast Guard training records, he obtained the following qualifications:

- Response boat small (RBS) 20 crewmember, May 2007
- SPC-LE crewmember, October 2007
- SPC-LE pursuit crewmember, December 2007
- UTB crewmember, November 2007
- UTB and SPC-LE coxswain, July 2008
- UTB and SPC-LE tactical crewmember, December 2008
- UTB and SPC-LE tactical coxswain, March 2009
- SPC-LE pursuit coxswain, July 2009

Boat engineer. The boat engineer, a machinery technician third class, age 29, was seated in the aft starboard seat at the time of the accident. According to Coast Guard training records, he obtained the following qualifications:

- UTB crewmember, May 2007
- UTB engineer, October 2007
- SPC-LE pursuit crewmember, October 2007
- SPC-LE tactical crewmember, December 2007

Crewmember-in-training. The crewmember-in-training, a machinery technician third class, age 20, was standing next to the starboard bench seat at the rear of the cabin at the time of the accident. He attained the rank of machinery technician third class in April 2009 and had served on board the Coast Guard cutter *Chase* before his assignment to Station San Diego.

²⁰ A response boat small, or RBS, is similar in design to the 33-foot-long SPC-LE; however, the RBS is 25 feet long.

According to Coast Guard training records, he had not yet obtained any boat-related qualifications.

Work/rest history. Only the two *CG 33118* crewmembers who agreed to be interviewed by NTSB investigators provided their work-rest schedules. However, the work record of the crew indicates that all five crewmembers maintained the same work schedule in the 72 hours preceding the accident. Crewmembers reported for duty at 0700 on Friday, December 18, 2009, and remained at the station in duty status until 0700 Saturday, December 19. They then entered day-worker status until 1600 on Saturday, December 19. On weekends they would ordinarily be relieved an hour later and as a result, the crew reported for duty at 0800 on Sunday, December 20, the day of the accident. During the duty periods, the crew was expected to be readily available to respond to Coast Guard situational needs. When not responding to these needs, sleep facilities were available to crewmembers and they were expected to use these facilities as needed. The facilities were three-person bedrooms, each with its own bathroom.

The boat engineer told investigators that the night before the accident he had stayed out late. He estimated that he fell asleep about 0300 and woke about 0630 on the morning of the accident. He worked a 12-hour shift that day, beginning at 0700. He told investigators that he took an afternoon nap that day. About 1630, a station petty officer told him to report to the armory to prepare for patrol.

The boat engineer told investigators that, the day before the accident, Saturday, December 19, he worked from 0600 to 1600. The day before that, Friday, December 18, he worked from 0700 to 1600. He stated that he had a good night's rest Thursday night into Friday, but his amount of sleep that night was not known, nor was his amount of sleep Friday night into Saturday.

The crewmember-in-training told investigators that on the day of the accident he arrived at work at 0800 and began preparing for patrol in the bay about 1645. His work schedule in the days prior was not known. He told investigators that, during the weekend of the accident, he went to sleep about 2130 or 2200 and woke about 0630.

1.5.2 Sea Ray

The Sea Ray operator, age 44, had more than 100 hours of experience as a boat operator. He had no formal operating training and had not taken a boating safety course, nor was he required to do so under California boating law.

1.6 Vessel Information

1.6.1 *CG 33118*

The *CG 33118* was manufactured in February 2007 by SAFE Boats International in Port Orchard, Washington,²¹ and ultimately delivered to Station San Diego later that same year. The

²¹ The vessel is a configuration of the 33-foot-long "Defender Class" SAFE Boat.

SPC-LE is a multimission²² boat, purchased by the U.S. Department of Homeland Security (DHS) for use by both the Coast Guard and U.S. Customs and Border Protection with minor equipment differences.²³ As of 2010, the Coast Guard operated 58 SPC-LE vessels. Several other agencies and municipalities also operate 33-foot SAFE Boats. The admiral in charge of the Eleventh Coast Guard District, which includes San Diego, told NTSB investigators that the *CG 33118* was assigned to national border units for border-related missions²⁴ and that the vessel had very good seakeeping and far-off-shore capability.

The SPC-LE Boat Operator's Handbook stated that the vessel's cruise speed was 35 knots at 4200 engine rpm, and its range at this speed was 250 nautical miles (nm) on one tank of fuel.²⁵ The handbook also stated that the vessel could operate up to 50 nm offshore, in wind up to 30 knots, and in rolling seas of up to 8 feet.²⁶ In reply to the contract solicitation, SAFE Boats asserted that the vessel would be able to have a zero-to-plane time under 3 seconds, turn in a radius of less than one boat length, and stop in less than 13 seconds, all while vessel controllability was being maintained.

The *CG 33118*, like all SPC-LEs, had a deep-vee rigid monohull constructed of welded marine grade aluminum with a watertight, self-bailing deck and a blended polyurethane membrane collar reinforced with a woven polyester base cloth. The vessel had an enclosed cabin with shock-absorbing seating for four crewmembers (**figure 5**) and a small bench seat aft on each side. The vessel's operating controls were contained within the cabin. A cuddy cabin²⁷ was located forward of the main cabin area and provided additional bench seating. The *CG 33118* was fitted with two blue law enforcement lights mounted at the base of the radar pod, and a siren.

²² The Coast Guard has 11 stated missions: ports, waterways, and coastal security; drug interdiction; aids to navigation; search and rescue; living marine resources; marine safety; defense readiness; migrant interdiction; marine environmental protection; ice operations; and other law enforcement. According to the SPC-LE Boat Operator's Handbook, the vessel is suitable for all of those missions, except ice operations. The Coast Guard intends its vessels to be used for more than one mission.

²³ Department of Homeland Security, SPC-LE specifications, August 18, 2006, noted that typical SPC-LE missions include locating, tracking, and intercepting suspicious vessels entering U.S. waters as well as maintaining port security.

²⁴ The district commander also stated that he expected Coast Guard personnel to be able to shift missions as quickly as needs dictated. He stated that a station boat could be under way on a law enforcement mission, be diverted to a search-and-rescue mission, and then be diverted back to a law enforcement case, all in the course of the same patrol.

²⁵ All SPC-LE Boat Operator's Handbook performance parameters were based on triple 275-hp outboard engines.

²⁶ The Coast Guard magazine *Proceedings* stated in its fall 2007 edition, page 13, that the SPC-LE "with top speeds in excess of 50 knots, a range of more than 200 miles, and over-the-horizon command, control, and communications is an extraordinarily capable shore-based response asset."

²⁷ A cuddy cabin is a small cabin on a vessel, usually not high enough to stand up in.



Figure 5. Interior of the CG 33118 cabin.

SPC-LEs are equipped with a scalable integrated navigation system (SINS) built around a radar chart plotter. The SINS includes a radar antenna,²⁸ a 10.4-inch color LCD surface radar-chart plotter display (with range scales from 0.125 to 24 nautical miles), a differential global positioning system²⁹ (DGPS) receiver and navigator display, a multidisplay repeater, a heading sensor, and a depth sensor. The vessel's communication system consists of a loudhailer,³⁰ an ultrahigh frequency³¹ (UHF) marine radio, two VHF-FM marine radios, and a high-frequency-single-sideband³² (HF-SSB) marine radio.

²⁸ The crewmembers who could have verified whether the radar was used declined to speak with NTSB investigators.

²⁹ DGPS is an enhancement to GPS. In addition to receiving satellite-based information, DGPS also receives and computes data from known, ground-based reference stations, which enhances position accuracy.

³⁰ A loudhailer is a multipurpose device for audio amplification.

³¹ A UHF radio uses frequencies between 300 and 3,000 megahertz.

³² Single sideband modulation uses all available transmitter power to convey information using voice or digital means for long-range communications.

Personnel at the NTSB's vehicle recorder laboratory examined the *CG 33118*'s radar and DGPS display units to determine if the components had recorded the vessel's trackline, speed, and locations leading up to the collision. However, no usable information was available on either unit because the units were not configured to record the information nor were they required to be.

In addition, the *CG 33118* was equipped with an L-3 ProTec AIS that could transmit both standard and restricted signals; however, no AIS data from the vessel registered at any receiving stations on the night of the accident. (For more information, see section 1.15.3 on AIS operation on the *CG 33118*.)

The *CG 33118* was originally outfitted with three 275-hp engines, which were replaced at Station San Diego with three 300-hp gasoline-powered Mercury Verado engines. Coast Guard personnel responsible for maintenance of the station's SPC-LEs told NTSB investigators that the reliability of the 300-hp engines was better than that of the 275-hp engines and that the *CG 33118* was as reliable as the other two SPC-LEs at the station. He further stated that he knew of no outstanding problems with the *CG 33118* either before or after the accident.

The *CG 33118* had accrued a total of 2,340 operating hours up to the date of the accident. The last logbook maintenance issue for the vessel involved an engine overheating at idle on December 5, 2009; no other discrepancies were noted from that time until the accident. The SPC-LE was last operated twice on December 18, 2009, two days before the accident. Neither of the coxswains who operated the *CG 33118* on that date, one of whom was the accident coxswain, noted any operating anomalies in the vessel's logbook. Available engine data from the *CG 33118*'s three engines was downloaded at Sector San Diego on December 22, 2009, under NTSB supervision. The downloaded information was limited to engine alarm codes.

The SPC-LE Boat Operator's Handbook does not include information about the vessel's forward visibility. (For more information, see section on Tests and Research.)

1.6.2 Sea Ray

The 24-foot-long recreational boat was manufactured by Sea Ray Boats Incorporated in Knoxville, Tennessee. The boat was a model year 2003 Sea Ray Sundeck® Sports Boat, designated by the manufacturer as a model 240SD. It had a fiberglass reinforced plastic hull with stainless steel outfitting and trim. The boat was styled as a bow rider, allowing for seating forward of the operator. The engine was a gasoline-powered Mercury Marine Mercruiser 350 Mag MPI Inboard/Outboard rated at 300 hp.

The boat's stated capacity was 12 persons or 2,000 pounds, and up to 2,100 pounds total including gear for the boat and passenger weight. At the time of the accident, 13 people (6 adults and 7 children), were on board. NTSB investigators did not obtain the individual weights of the Sea Ray occupants. To estimate the weight of the occupants at the time of the accident, NTSB investigators used current Federal Aviation Administration (FAA) standard weights for adults and children. Based on FAA weight assumptions, the Sea Ray passengers weighed about 1,490

pounds, or about 600 pounds less than the vessel's rated maximum 2,100-pound passenger-plus-gear load. No substantial equipment or provisions were on board.

The navigation lights on the Sea Ray consisted of a red port and green starboard sidelight and a removable all-around white light, which 33 CFR 83.21(e) defines as "a light showing an unbroken light over an arc of the horizon of 360 degrees." The all-around white light may also function as a stern light on vessels less than 12 meters (39.4 feet) in length, as specified in the inland navigation rules. The all-around light was mounted on the centerline of the transom at the stern of the Sea Ray. Vessel lighting was required to meet the inland navigation rules for vessels the size of the Sea Ray: Annex 1 of 33 CFR Part 84 states that, for inland navigation, an all-around light on vessels less than 12 meters in length should be positioned at least 1 meter (3.28 feet) higher than the sidelights and be visible at a minimum range of 2 miles. The 5.1-foot-high post that supported the light allowed the light to be located above a Bimini top on the Sea Ray (which was lowered on the night of the accident), allowing for 360-degree visibility. The Sea Ray operator stated that he replaced the light bulb about 2 months before the accident with a clear wedge-base bulb found to be rated at 9 watts and 0.69 amps. NTSB investigators determined that the replacement bulb had a light output of 6 candela, or candlepower, the same as the original manufacturer's bulb. (Also see section 1.7.2 on Sea Ray wreckage.)

1.7 Wreckage

1.7.1 CG 33118

The *CG 33118* sustained surface scratches and paint transfer starting at the beaching plate³³ at the stem and continuing aft along the keel for about three-quarters of the length of the hull (**figure 6**). The crewmembers indicated that they did not notice any major postaccident problems with the vessel's performance on the way to impoundment at Coast Guard San Diego's helicopter hanger.

³³ A beaching plate is a keel guard that protects the hull from abrasion during beach landings.



Figure 6. Damage to the CG 33118.

1.7.2 Sea Ray

Most of the Sea Ray's damage was located above its water line, from the starboard side of the transom and extending forward of the port windshield (**figures 7 and 8**). The port window was torn off and the remaining frame bent outward. The fiberglass at the sheer below the missing port window had failed and cracked down the length of the remaining window frame. The door to the head,³⁴ located just below the port window, was knocked off and pushed inward. The swim platform in the stern had a sharp gouge on the starboard side. The structural fiberglass damage to the Sea Ray rendered the vessel beyond repair.

The Sea Ray's all-around light pole was bent and found lying in the vessel, separated from its transom mounting socket. Following the accident, the California Highway Patrol's Multidisciplinary Accident Investigation Team (MAIT) analyzed the Sea Ray's all-around light to determine if it had been illuminated at the time of the collision.³⁵ MAIT investigators determined that material transfer from the light bulb's filament to the light's envelope as well as blue and green discoloration of the bulb's filament indicated that the bulb was hot and the light illuminated at the time of the collision.

³⁴ The head is the onboard bathroom.

³⁵ Supplemental MAIT Case No. BL-003-10, Vessel Collision Report No. 09-8157A, San Diego Harbor Police.



Figure 7. Damage to the Sea Ray.



Figure 8. Fractured fiberglass on the Sea Ray, viewed looking aft and port from inside the boat's cockpit.

1.7.3 Strike Angle

NTSB investigators calculated the strike angle by taking location measurements of the damage to both vessels. The strike angle to the Sea Ray was estimated to be about 11 degrees to starboard (**figure 9**).

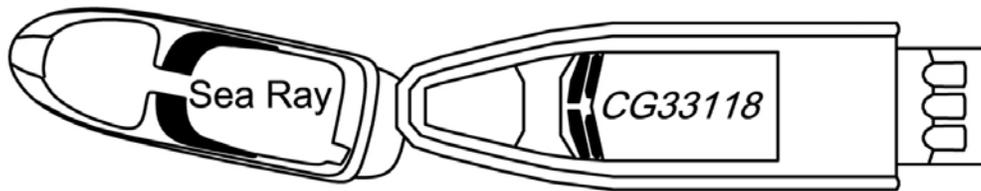


Figure 9. Depiction of the CG 33118 colliding with the Sea Ray at an angle of about 11 degrees.

1.8 Waterway Information

1.8.1 General

The distance from Harbor Island to the main shipping channel is about 800 yards. The width of the bay in the accident area, between Harbor Island and North Island, is about 1,350 yards. The water depth in the accident area is about 28 feet. According to the *Coast Pilot*, San Diego Bay does not have excessive tidal current movements.

1.8.2 Vessel Traffic Density

Vessel density in San Diego Bay was considered heavy at the time of the accident. SDHP officers stated that on the night of December 20, 2009, the bay was congested with hundreds of boaters because of the Parade of Lights. One officer characterized the Parade of Lights as bringing “one of the highest amounts of boat traffic on any given date in San Diego Bay.” In its accident report, SDHP noted that its vessel therefore responded to the collision “at a slow rate of speed due to the very heavy vessel traffic.” Witnesses also characterized heavy traffic density from the north end of Shelter Island to the Hilton Hotel on Harbor Island, along the parade route. As noted earlier, the Sea Ray operator estimated that about 20 vessels were within 50 yards of his boat at the time of the accident. Many spectator vessels were located near the West Basin inlet. As the parade moved northeast along Shelter Island and turned east to parallel Harbor Island, spectator vessels located near the West Basin inlet would have been primarily to the left of the parade route. Other than the spectator vessels near the West Basin inlet, vessels were also located along the shore of Harbor Island. **Figure 10** shows conditions near the accident site.



Figure 10. View of San Diego Bay looking southwest from the sixth floor of the Hilton Hotel near the western end of Harbor Island before and after the collision. The two combined photos illustrate the waterway traffic before the accident (right) and the location of the accident site (left). The CG 33118's approximate path to the West Basin would have been from the left to the right through the combined photos. (These two photos were the best available, and were taken as close as possible to the time of the accident.) Photo courtesy of T. Beckman.

A crewmember on board the *Silver Fox III*, a Coast Guard Auxiliary vessel positioned near the west end of Harbor Island to keep spectator vessels south of a perimeter line off the island, said that 30 to 40 spectator vessels were in the area, including kayaks and some vessels with no navigation lights. He said that his vessel was 200 feet from the *Sea Ray* when the accident occurred. The *Silver Fox III* crewmember said that the *Sea Ray* was struck just outside the area where the spectator vessels were concentrated.

Figure 4 in section 1.2.2, Accident Narrative, *CG 33118*, depicts the approximate path that the *CG 33118* took leading up to the accident.

1.8.3 San Diego Bay Background Lighting

Coast Guard coxswains who regularly operated on San Diego Bay told NTSB investigators that background lighting from the city at night makes it difficult to differentiate between vessel navigational lights and lights on the shore. SDHP also stated that navigating in the bay at night was “challenging” due to the background lights making it “difficult to distinguish lighting on shore from lighting by navigational aids or other vessels.” The police further stated that experience was required to recognize navigation lights and boats on the water because of the conditions in certain parts of the bay.

1.9 Meteorological Information

The sun set at 1646 on the day of the accident. The moon was a waxing crescent, with 19 percent of its disk illuminated. Observations at San Diego International Airport, less than 1 mile from the accident location, noted an unrestricted visibility of about 10 miles, a few clouds at

12,000 feet above ground level, and a broken ceiling at 22,000 feet. According to an NTSB weather study, the broken to overcast cloud cover reduced the illumination from the moon at the time of the accident.³⁶ The wind was from the south-southeast at about 3 miles per hour. The air temperature was 63° F, and the water temperature was 60° F. The bay was calm.

1.10 Medical and Pathological Information

About 5 hours after the accident, the five crewmembers on the *CG 33118* were tested for the presence of illegal drugs and alcohol at Naval Hospital Balboa.³⁷ All results were negative. The Sea Ray operator was tested about 6 hours after the accident and those results were negative as well.

The fatality was an 8-year-old boy who was a passenger on board the Sea Ray and was the son of the operator. The cause of his death was determined to be multiple blunt force trauma. Four other passengers on board the Sea Ray received serious injuries: a 37-year-old male suffered a scalp laceration and skull fracture; his son, age 3, suffered a concussion and lip laceration; a 39-year-old male passenger sustained a scalp laceration; his son, age 4, suffered a skull fracture, a concussion, and a deep laceration. No one on board the *CG 33118* was injured.

1.11 Survival Aspects

The Sea Ray passengers were evacuated from the damaged boat and taken to shore on three vessels. The *CG 33118* was the first vessel to assist the passengers. The crew turned around immediately after the collision and brought the vessel alongside the Sea Ray. The 8-year-old boy, who was the most severely injured, was removed from the boat, placed on board the *CG 33118* with a physician who had been on a nearby vessel. They were taken to the Harbor Island fuel dock on the west end of Harbor Island, where San Diego Fire and Rescue had dispatched an ambulance and a fire engine to meet the vessel. The ambulance transported the 8-year-old boy and the physician to University of California, San Diego (UCSD) Medical Center, where the boy later died from his injuries.

The occupants of a nearby 26-foot-long Bayliner also assisted in the evacuation after hearing about the accident on VHF radio channel 16. Its operator and a passenger, both Navy surgeons, offered medical assistance. When they arrived at the Sea Ray, *CG 33118* already had departed with the injured 8-year-old, and no other response assets had yet arrived. The two physicians boarded the Sea Ray and began helping the injured.

³⁶ Weather Study, NTSB Office of Aviation Safety, December 22, 2009.

³⁷ Federal regulations at 46 CFR Part 4.06 did not apply in this accident. 46 CFR Part 4.06 requires postaccident drug and alcohol testing on all individuals engaged in or employed on board a commercial vessel who are directly involved in any accident meeting the criteria of a serious marine incident as defined at 46 CFR 4.03-2. On June 20, 2006, new Coast Guard regulations (46 CFR 4.06-3) took effect requiring alcohol testing within 2 to 8 hours of a serious marine incident and the collection of drug-test specimens within 32 hours. The five drugs for which tests are conducted are amphetamines, cocaine, marijuana, opiates, and phencyclidine.

Sea Tow, a local vessel assistance company, dispatched a vessel after hearing about the collision on VHF radio. The Sea Tow vessel arrived at the scene shortly after the two Navy surgeons. Though not typically used as a rescue vessel, the Sea Tow vessel took the injured on board at the request of the Sea Ray passengers. Eight people from the Sea Ray (two men, two women, two boys, and two girls), including the four seriously injured passengers, were transported by the Sea Tow vessel to the Bali Hai Restaurant dock on the north end of Shelter Island, which the Sea Tow operator believed to be closest to the accident location. He estimated that it took 10 minutes to reach the dock.

The remaining four passengers on the Sea Ray (the operator, one woman, and two boys) were taken to the Bali Hai dock by one of the two physicians on the Bayliner. The other physician stayed on board the damaged Sea Ray to assist in towing it to shore. Vessel Assist, another marine assistance company operating on the bay, towed the boat.

Because of the Parade of Lights, several Coast Guard and SDHP vessels were operating on the bay at the time of the accident. The *Haddock's* commanding officer told investigators that about 1745, after hearing VHF radio communication about the collision, he diverted from the parade to assist. Four crewmembers from the *Haddock*, one trained as an emergency medical technician, assisted the injured passengers at the Bali Hai dock.

Alerted to the collision via radio communications, SDHP responded by sending four vessels, two to assist at the Bali Hai dock, one at the Harbor Island fuel dock, and one remaining on standby near Harbor Island. A responding officer indicated that he and another SDHP crewmember approached the accident slowly because of the heavy vessel traffic density in the area from the ongoing Parade of Lights event.

Three ambulances transported the four seriously injured passengers from Shelter Island to hospitals. Two of the ambulances transported the two injured men to UCSD Medical Center. The third ambulance transported the two injured children to Rady's Children's Hospital. The remaining eight passengers were taken either to UCSD Medical Center or Rady's Children's Hospital, depending on where their injured family members were.

Figure 11 details the approximate location of each passenger on board the Sea Ray at the time of the accident and the severity of their injuries, based on medical records and interviews with surviving passengers. The four seriously injured passengers and the fatally injured boy were all seated in the rear half of the vessel. Those sitting or standing forward of the operating station received either minor injuries or none at all.

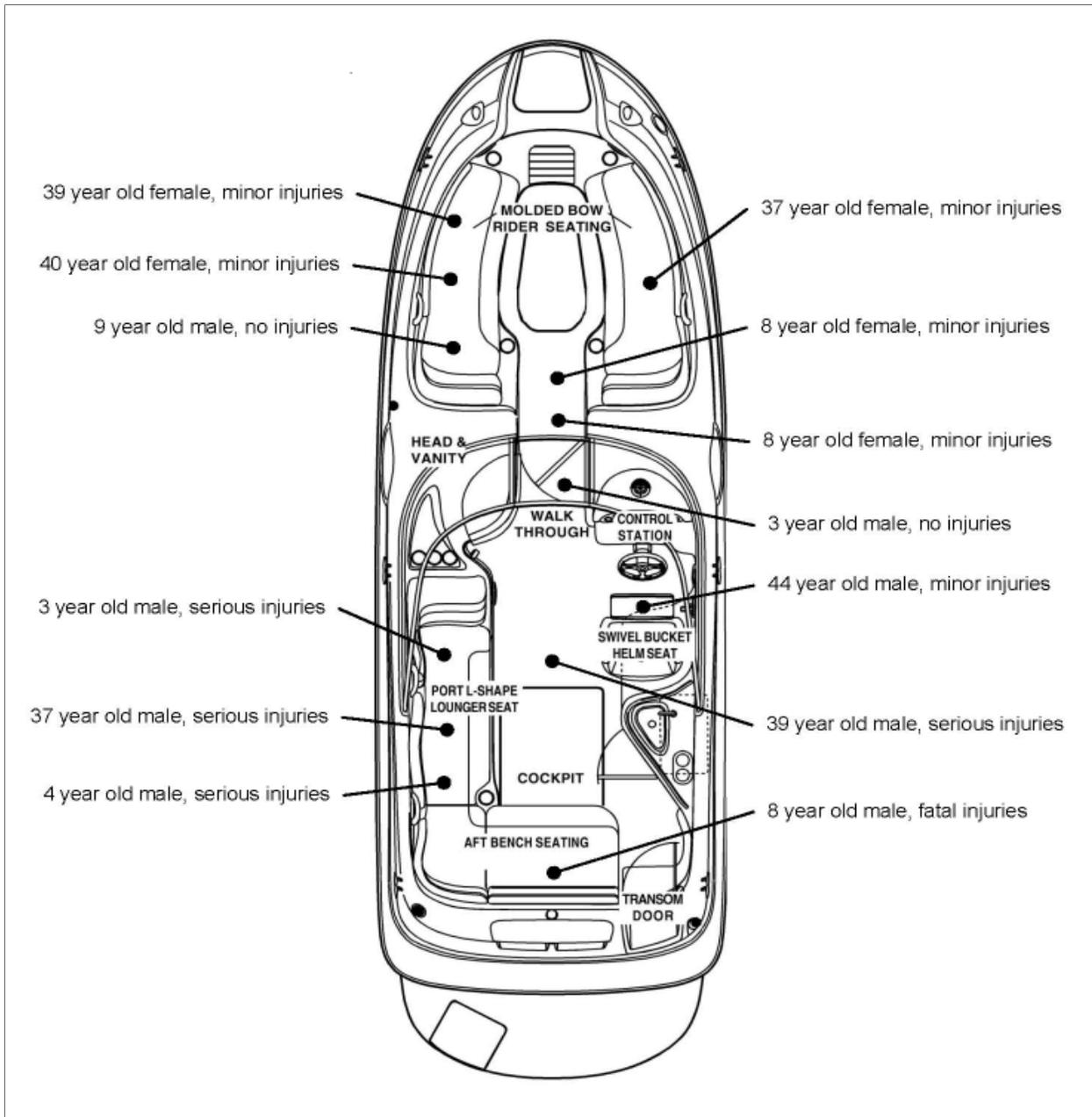


Figure 11. Layout of the Sea Ray and locations and injuries of the 13 people on board.

1.12 Management/Coast Guard Operational Information

1.12.1 Guidance on Parade of Lights Operations

NTSB investigators interviewed six coxswains assigned to Station San Diego, none of whom had served as coxswain during a Parade of Lights. Only one coxswain had participated in any other large event in San Diego, a marine event in Mission Bay north of San Diego Bay. All of the interviewed coxswains stated that no speed limits for Coast Guard or other vessels had

been established in connection with the Parade of Lights, and that they were not aware of any risks or modifications to Coast Guard operating procedures specific to the event.

1.12.2 Small Boat Speed Guidance

The Coast Guard Boat Operations and Training Manual, Volume I, stated, “All personnel operating Coast Guard boats are obligated to abide by Inland and International Navigational Rules.” Rule 6 of the navigation rules stated in part, “Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.” Rule 6 further specified factors to be considered in determining safe speed, including visibility, traffic density, maneuverability, and background light” (see Appendix B).

In addition, the Coast Guard’s Boat Crew Seamanship Manual provided crewmembers with “approved methods and procedures for the conduct of Coast Guard boat operations.” Under “appropriate speed,” the manual stated, “Running at full speed all of the time should be avoided” and “finding a speed that offers a comfortable ride as well as allows mission completion is advised.” The manual listed factors that should be considered to determine safe speed, including high seas, traffic density, visibility and shoal waters. With regard to traffic density and visibility, the manual stated:

Do not use high speed in high traffic density areas. A safe speed allows response to developing situations and minimizes risk of collision, not only with the nearest approaching vessel, but with others around it. ... If conditions make it difficult to see, slow down. ... Darkness and steering directly into the sun lessens ability to see objects or judge distances.

The manual also required coxswains to be aware of and responsible for the wake that their vessels create when in enclosed waters or near other vessels, and for injuries or damage that may result from excessive vessel wake. Under “wake awareness” the manual said, “Only an unaware coxswain trails a large wake through a mooring area or shallows, tossing vessels and straining moorings. ‘Get-home-itis’ and a false sense of urgency are two reasons coxswains forget to watch their wake.”

The Boat Crew Seamanship Manual also stated that the coxswain should “choose a boat speed that enables lookouts to effectively and safely perform duties” and to “position lookouts so they can effectively and safely perform their duties under the operating conditions (e.g., restricted visibility, boat speed, sea state, weather).”

The Coast Guard Navigation Standards Manual (Commandant Instruction M3530.2c) directed officers in charge (OICs) of local stations to establish navigation standards for small boats as appropriate to their respective operating areas. Station navigation standards were required to include certain navigation criteria. With regard to speed, OICs were instructed to “describe areas where boats must adhere to no wake zones or speed limits during operations.” Pursuant to this requirement, Station San Diego established piloting and navigation standards that prohibited coxswains from exceeding the vessel’s operational cruising speed unless operational necessity or law enforcement missions so required. Station San Diego navigation

standards listed the SPC-LE cruising speed as 4200 rpm³⁸ (about 35 knots) and the UTB cruising speed as 2430 rpm.³⁹ No other speed restrictions were established for San Diego Bay.

Station San Diego navigation standards identified four geographic areas—all outside San Diego Bay—in which “slow speed” was to be used: Imperial Beach, Point Loma, the entrance to Mission Bay, and the entrance to Oceanside Harbor. Station San Diego also required coxswains to operate their vessels “with extreme caution” when close to known hazards or shoals during times of restricted visibility or darkness.

In addition, Station San Diego navigation standards informed coxswains to consider operating conditions in choosing particular speeds of their vessels: “Reduced ability to see vessel traffic, hazards, or navigation reference points in low visibility or at night add extra risk factors while navigating. Reduced visibility, either from night or weather conditions, usually dictates the need for reduced speed, even when responding to a potential life threatening case.”

The San Diego-based Coast Guard coxswains that NTSB investigators interviewed confirmed that, with regard to speed, they were taught Rule 6 of the navigation rules of the road. The coxswains added that when considering operating speeds, they were directed to use their best judgment and experience. They told investigators that they considered their “comfort level with” the number and proximity of boats in their vicinity when determining vessel operating speeds.

They also said that they considered Rule 6 in determining safe speed, but that they routinely operated the SPC-LEs at 4200 rpm, both day and night, on San Diego Bay. The coxswains stated that, in general, they discussed safe speed with coxswain trainees. They reinforced safe speed considerations while under way by reviewing Rule 6 elements for determining a safe speed based on prevailing circumstances and conditions. They told coxswain trainees to evaluate the conditions in judging what speed was safe.

The *CG 33118* crewmember-in-training told NTSB investigators that he had been on SPC-LEs operating at “full throttle”⁴⁰ at night on San Diego Bay. The former Station San Diego OIC, the station executive petty officer, and the station training officer told NTSB investigators that coxswains had the authority to exceed the cruising speed if they determined that the situation called for it, such as during search-and-rescue or law enforcement. The former station OIC told NTSB investigators that he would have expected coxswains to request his permission to use higher speed, but Station San Diego had no established procedures to that effect.

³⁸ The former Station San Diego OIC, who issued the navigation standards in place at the time of the accident, told NTSB investigators the 4200-rpm limit in the navigation standards applied to day and night operations.

³⁹ Coast Guard small boats have different cruising speeds. According to Coast Guard Boat Forces personnel, small boat cruising speeds are typically based on the most economical speed a boat can travel.

⁴⁰ 5300 rpm, or about 44 knots.

1.12.3 Crew Brief

Coast Guard Navigation Standards called for crewmembers to hold an informal brief for the entire boat crew before getting under way or entering restricted waters. The brief was to include a risk assessment associated with the mission, referred to as a green-amber-red (GAR) model. The GAR considered supervision, planning, crew selection, crew fitness, environment, and event complexity. Station San Diego navigation standards required crews to notify the OIC if the GAR scored amber or higher. The *CG 33118* boat engineer told NTSB investigators that the crew performed a GAR before getting under way on the evening of the accident, and that it scored "green." The crewmember-in-training did not remember whether a GAR was conducted.

1.12.4 Coxswain and Crew Training

Coast Guard personnel did not apply to become coxswains; they qualified by completing the boat crewmember and coxswain qualification program. The qualification program established minimum standards of "knowledge, performance, and currency" for all personnel (regular, reserve, and auxiliary) serving as crewmembers on Coast Guard vessels. To qualify for either boat crewmember or coxswain, Coast Guard personnel had to complete required classroom and underway training and demonstrate proficiency in the particular qualification. Coast Guard boat crews would vary through the qualification process; that is, they would serve under, and work with, different crewmembers.

Before coxswains could qualify for their positions, they had to qualify as boat crewmembers. Boat crewmembers needed to complete 92 tasks to qualify for that position, and coxswains an additional 82 tasks, including crew efficiency and team coordination, boat handling, rules of the road, piloting and navigation, search-and-rescue, and towing and salvage. Trainees were apprenticed to instructors who guided them through the qualification phase and provided them with hands-on training and assistance with the program of study.

Both boat crewmembers and coxswains needed to complete an oral exam, which tested the applicant's knowledge of Coast Guard policies and procedures, the local area, navigation and seamanship, pertinent technical data for the boat type for which the trainee was being certified, team coordination and risk assessment standards and concepts. Applicants were assessed on their maturity, judgment, attitude, and professionalism; willingness to accept the duties and responsibilities of a coxswain; detailed knowledge of the unit's operational area including knowledge of the unit's boat piloting; and navigation instruction.

Once qualified, coxswains and boat crewmembers had to meet currency requirements, either through normal operating performance or through dedicated training. This included a minimum of 40 hours under way (including 10 nighttime hours) every 6 months. No mission-specific performance was required, and all underway hours sufficed.

The *CG 33118* coxswain attended boatswain's mate "A" school, a 12-week training program. Students were exposed to the many facets of boatswain's mate rating, including

navigation, rules of the road, and team coordination training (TCT).⁴¹ Students also received first-aid and CPR certification and conducted practical underway exercises on 41-foot-long UTB vessels.

Station San Diego coxswains told NTSB investigators that the Coast Guard's TCT instructed even the most junior persons on a Coast Guard boat to speak up should they feel "uncomfortable" or see what "they think is a violation of rules."

1.12.5 Lookout Procedures

The Boat Crew Seamanship Manual describes watchstanding responsibilities, including performing the lookout watch. On Coast Guard small boats, "although not specifically assigned the duty of lookout, the entire crew must perform lookout duties unless directed otherwise. ... Lookouts must report to the coxswain everything seen, smelled, or heard as well as everything they think they see, smell, or hear. If in doubt, report it!" The manual also provides guidelines such as remaining alert; speaking loudly when making a report; repeating a report until acknowledged by coxswain; when in doubt, report it; report floating objects; and make certain duties are understood. These guidelines also included that if conditions impaired the lookout's ability to see, smell or hear, the lookout should report the condition to the coxswain.

1.12.6 Coast Guard Boat Forces Oversight

Station San Diego coxswains were commanded by a Coast Guard station commanding officer, who was overseen by an operational commander at Sector San Diego.⁴²

The Coast Guard regularly evaluated the readiness and proficiency of boat forces personnel through Ready for Operations (RFO) and Standardization (STAN) team evaluations. RFO evaluations, which were conducted annually at the station level, assessed boat crew training, survival systems, and personal protective equipment programs to evaluate compliance with Coast Guard policies and procedures. RFO evaluations also included material inspections and underway exercises. RFO evaluations were conducted by the station's operational command, in this case, Sector San Diego. Station San Diego's most recent RFO evaluation before the accident was conducted December 2–3, 2009. In this evaluation, the RFO team concluded that "all boat crews operated safely and competently" during the drills. The RFO team also reviewed Station San Diego's training program and did not note any discrepancies. Station San Diego's coxswains averaged a score of 90.3 percent on the RFO knowledge-based written tests. The unit

⁴¹ The Coast Guard established TCT requirements through Commandant Instruction 1541.1 to increase team effectiveness in cutter, boat, and command/control operations and activities. TCT addressed seven critical skills that reduce the risk of mishaps: leadership, mission analysis, adaptability and flexibility, situational awareness, decision making, communication, and assertiveness. The skills were meant to control safety risks and improve team performance by way of risk management, crew briefing, and crew debriefing. Coast Guard boat crews were expected to apply these TCT skills to prevent mishaps. The *CG 33118* crewmembers had completed and were current with their annual TCT requirements.

⁴² Oversight of Station San Diego coxswains was generally provided by a senior enlisted OIC. About 2 weeks before the accident, the OIC was relieved of command for inappropriate behavior and was replaced by a lieutenant, the Sector San Diego Enforcement Division Chief.

received an overall score of 37/50 and was deemed ready for operations. The minimum score that a unit could achieve to maintain its RFO status was 33. The RFO coordinator noted, in reference to Station San Diego personnel, that “the crew continues to impress me with their professionalism and team work.”

The RFO evaluation mirrored the biennial STAN assessments. The STAN assessments, conducted at the national level, evaluated the performance of individual stations at least every 2 years. The nationwide STAN mean assessment score for FY10 was 38/50 for the 145 completed assessments. Station San Diego’s most recent STAN assessment before the accident was in early 2008. After the accident, a STAN assessment, which had been scheduled before the accident, was conducted January 11–14, 2010. Station San Diego SPC-LE crewmembers, with the exception of the *CG 33118* crew, participated in the STAN evaluation. The station’s overall score in the January 2010 STAN evaluation was a 40/50, and it was deemed ready for operations.

Station San Diego received perfect scores in the underway exercises and training program assessment. The station received 3 points of a possible 5 on the knowledge-based written test.⁴³ The average score for Station San Diego’s SPC-LE coxswains was 81.1 percent. They scored lower than 81.1 percent on two of the five sections of the test, with scores of 58.6 percent on navigation rules testing and 71.4 percent on piloting and navigation testing. In the station underway exercises, only one drill failure was noted out of 24 total drills. Drills were conducted on both SPC-LE and 41-foot vessels.

1.12.7 The *Bayside Blaster* Accident

About 2013 eastern standard time on January 12, 2002, a 24-foot-long Coast Guard nonstandard⁴⁴ patrol boat from Coast Guard Station Miami Beach with two crewmembers on board was on a routine nighttime recreational boating safety patrol in Biscayne Bay, Florida, when it collided with the small passenger vessel *Bayside Blaster*, carrying 2 crewmembers and 53 passengers.⁴⁵ The patrol boat was operating at the Coast Guard Station limit of 4000 rpm (equivalent to 32 knots) in a no-wake zone. The local station had set the 4000-rpm limit for normal, nonemergency operations.

The NTSB determined that the probable cause of the accident was the failure of the Coast Guard coxswain to operate the vessel at a safe speed in a restricted-speed area frequented by small passenger vessels and in conditions of limited visibility due to darkness and background lighting. Contributing to the cause of the accident was the lack of adequate Coast Guard

⁴³ Written test results accounted for 10 percent of a team’s overall performance in both the RFO and STAN team assessments. The written assessments were not treated as pass or fail, rather, as a portion of the overall performance in the assessment.

⁴⁴ At the time, several Coast Guard stations operated a variety of station-specific small boats purchased locally by each Coast Guard district to suit a station’s operational requirements. Because the purchase and management of these boats was not coordinated nationally, the Coast Guard identified these vessels as “nonstandard” boats.

⁴⁵ *Collision Between the U.S. Coast Guard Patrol Boat CG242513 and the U.S. Small Passenger Vessel Bayside Blaster, Biscayne Bay, Florida, January 12, 2002*. Marine Accident Report NTSB/MAR-02/05 (Washington, DC: National Transportation Safety Board, 2002).

oversight of nonstandard boat operations. The NTSB found no safety or law enforcement reason to employ excessive speed while conducting a routine patrol at night, in restricted waters, and close to shore. The NTSB noted that high speeds should be reserved for emergency responses, and it concluded that, even without the speed restriction, the speed the Coast Guard vessel used in the accident was imprudent for the prevailing conditions of darkness, background lighting, and potential for encountering passenger and recreational vessels in the area. The NTSB noted that several Coast Guard small boat accidents had prompted the Coast Guard to issue nonstandard boat operator's handbooks that cautioned against operating vessels at excessive speed. The NTSB report noted that, "The Commandant issued a directive for area and district commanders to publish operating limits for their nonstandard boats and reexamine each boat's suitability for its purpose."

The NTSB also concluded that the lack of Coast Guard policies and procedures regarding operating speeds for nonstandard boats at the time of the accident afforded coxswains too much latitude in determining speed and that Coast Guard oversight was inadequate at the time of the accident. Without some means of oversight, the NTSB noted, Coast Guard commanding officers cannot know that the speed limits are followed or that other safety requirements are met. Further, the NTSB said that oversight could be improved by direct observation of coxswain performance and solicitation of feedback from waterway users as well as greater formality in conducting routine patrols. As a result of its investigation of this accident, the NTSB issued the following recommendations to the Coast Guard:

Establish oversight procedures for use by the commanding officers or officers-in-charge of Coast Guard stations to improve the safety of Coast Guard routine small boat operations, including the institution of in-depth predeparture briefings, thorough predeparture checks of boats, monitoring of coxswain performance, and thorough postpatrol debriefings. (Safety Recommendation M-02-25)

Evaluate on an annual basis your program for reducing nonstandard boat accidents and for ensuring compliance with Coast Guard policies and procedures related to those vessels; publish the results annually for use by Coast Guard stations. (Safety Recommendation M-02-26)

In response to these recommendations, the Coast Guard reported that it published a revised Boat Readiness and Standardization Program Manual (COMDTINST MI6114.24B) that required continuous evaluation of readiness of boats and crews. The manual recommended that self-audited evaluations of material readiness and standardization also assess performance in team coordination, risk management, and crew briefings and debriefings as part of standard boat operations. The Coast Guard also tasked operational commanders to conduct annual RFO evaluations to determine unit compliance with Coast Guard policies and procedures, and to assess a unit's crew training program and underway exercise evaluation. As a result of the Coast Guard actions, on November 21, 2003, the NTSB classified both recommendations "Closed—Acceptable Action."

After the Biscayne Bay accident, Coast Guard headquarters issued the following directive to small boat force leaders: "Impress upon all hands that throttles have more than two [stop and

full] operational positions. ... Normal operating speeds must be something less than maximum speeds, and coxswains must have time to see, react, and avoid obstacle. ... The image of the young Coastie zipping along at max throttle is becoming a stereotype, reflects poorly upon our professionalism, and encourages reckless behavior in our developing boat crews.” After the accident the Coast Guard also stated the following in its Non-standard Boat Operator’s Handbook:

A high number of small boat mishaps can be attributed to excessive speed. ... As a crewmember, never hesitate to ask the coxswain to SLOW DOWN or take up a more forgiving heading. Safe operating speed is an element of prudent seamanship.⁴⁶

As a result of another Coast Guard small boat accident in 2001,⁴⁷ the Coast Guard required each area and district commander to publish operating limits for each boat type and reexamine each boat’s suitability for its purpose. Commanding officers were also required by the newly issued Navigation Standards Manual to impose specific operating restrictions (speed, distance from hazards, and frequency of fixes) on locations within the area of responsibility (AOR) identified as posing significant navigational or environmental risk to boats.

1.12.8 Nondistress Search-and-Rescue Assist Policy

At the time of the accident, the Coast Guard’s policies and procedures in search-and-rescue operations were included in an addendum to the United States National Search and Rescue Supplement, which in turn was a section of the International Aeronautical and Maritime Search and Rescue Manual. Part of the Coast Guard’s search-and-rescue addendum addressed instances in which a boater requested assistance but was not in distress. Under those circumstances, the Coast Guard policy was to offer to issue a MARB on behalf of the boater to request that other boaters or a private towing company in the vicinity come to the boater’s assistance. If no one responded within a “reasonable” period of time, the Coast Guard would send one of its boats to assist. Representatives of the Coast Guard’s Office of Search and Rescue told NTSB investigators that all Coast Guard personnel, including coxswains, received training in the nondistress policy. Although there were no written procedures, Sector San Diego personnel told NTSB investigators that a coxswain could decide to check on a nondistress vessel and was allowed to do so.

1.12.9 Coast Guard Postaccident Activity

The commanding officer of Station San Diego told NTSB investigators that, shortly after the accident, he issued verbal guidance limiting the speed of SPC-LEs to minimum speed⁴⁸ outside the main shipping channel. This new speed restriction was not incorporated into Station San Diego’s navigation standards, which were revised on July 29, 2010, and, as of the date of

⁴⁶ It was noted in the NTSB of the investigation of the *Bayside Blaster* accident that a recent DOT IG audit reported a 225% increase in accidents in FY 2000 over FY 1998 and that 56% of the accidents were caused by poor judgment or navigation and operational errors and hence were preventable.

⁴⁷ Because this accident did not involve a nonpublic vessel, the NTSB did not investigate it.

⁴⁸ Minimum speed is generally understood to mean idle speed, or 2–4 knots.

this report, were still current. The commanding officer stated that slower speeds would reduce the risk of collision but he did not think that Coast Guard boat operators were going too fast or operating unsafely during normal operations. Appendix C contains a letter from the commander of Sector San Diego concerning this verbal guidance on safe speed.

Also in the July 29, 2010, revision to the navigation standards, Station San Diego added the following:

The SPC-LE represents a unique challenge in safe speed determination. At lower rpm's the stern of the SPC-LE will squat, causing the bow to rise and limit the forward visibility of the crew (lookouts). Due to this design restriction, the SPC-LE shall not be consistently (more than a few seconds) operated at between 2000-3500 rpm's unless absolutely necessary to the assigned mission. For missions where slower speeds are extensively needed, the 41 [-foot-long] UTB should be considered the primary resource.

Following the December 20, 2009, collision of the *CG 33118* and a December 5, 2009, collision in Charleston Harbor, South Carolina, involving a 25-foot-long Coast Guard boat,⁴⁹ the Coast Guard commandant issued a message titled, "Leadership for Safe and Effective Boat Operations,"⁵⁰ to all Coast Guard units. In this message, the commandant discussed the need to ensure that all Coast Guard boat operators "have the time and focus to develop and maintain the skills needed to safely accomplish their very demanding missions." The message also announced that the Coast Guard vice commandant had directed the Coast Guard's force readiness command to conduct a systematic review of small boat operational doctrine, tactics, techniques, and procedures, which was to be completed by August 1, 2010. As of the date of this report, the review ("Boat Operations Safety Review") had not yet been completed. The vice commandant also called for the establishment of a boat forces advisory council "to provide a communications conduit between the field and headquarters" and to make recommendations on policy, doctrine, training, support, and acquisition issues affecting Coast Guard boat forces. The advisory council participated in the Boat Operations Safety Review, and is assessing whether to create a navigator position on Coast Guard high-speed boats.

The admiral in charge of the Eleventh Coast Guard District told NTSB investigators that the Coast Guard would not issue safety alerts targeted to its own operators before its investigations were completed because doing so could communicate information different from the findings of the completed investigations.

⁴⁹ A 25-foot Coast Guard vessel collided with a small passenger vessel outfitted with holiday lights in Charleston Harbor, South Carolina. On December 18, 2009, the Coast Guard issued a safety alert 09-09 for informational purposes, addressing how holiday lights can impair navigation lights on vessels. Also see section "Other Information, *Thriller 09* and *CG 25689* Collision."

⁵⁰ U.S. Coast Guard, ALCOAST 064/10, COMDTNOTE 16010, February 4, 2010.

1.13 Vessel Forward Visibility

1.13.1 General

The SPC-LE is considered a high-speed planing boat. The hull of such a vessel will rise, that is, be on plane, as the vessel attains higher speeds. As a vessel's speed increases, it passes from displacement to semidisplacement (transition) mode, to planing mode. Once a vessel is in planing mode, planing can be maintained with a slight reduction in engine power. Vessels typically reach their highest trim angle⁵¹ in the transition zone (**figure 12**). In general, planing boat operators avoid traveling in the transition zone because of the obstructive effects of the high trim angles on their forward visibility, and because of poor fuel economy. In addition, operating in the transition zone causes large wakes.



Figure 12. Stages of generic vessel planing and corresponding trim angles.

Visibility from the helm of the SPC-LE is therefore affected by the hull trim angle, which is itself affected by several factors: the weight and distribution of fuel, persons, and gear on board the vessel; vessel speed; sea conditions; trim position of the outboard engines; and the horsepower and rpm of the outboard engines. As on many planing boats, as the vessel transitions between displacement mode and planing mode, the hull is subject to its largest operating trim angle. A high trim angle reduces forward visibility because the height of the bow above the water line obstructs the operator's forward view of the water. Once the vessel reaches planing speed and the bow begins to trim downward, forward visibility improves.

An SPC-LE coxswain at Station San Diego stated that for her to have good visibility in the planing mode, the boat would need to be traveling at 3500 to 4000 rpm. She stated that if she traveled at an rpm below that, she could not see. She further indicated that if she did not want to travel at speeds higher than that rpm range, then she would travel in the displacement mode, at slow speed.

SDHP officers, who operate a 31-foot-long SAFE Boat,⁵² stated that while operating in the transition zone, the bow of the vessel can obstruct forward vision. The SDHP officers stated that they accounted for the reduced visibility zone by avoiding traveling in the zone's associated

⁵¹ Trim angle is the change in a vessel's inclination from the boat's design horizontal deck, or reference line, to the surface of the water.

⁵² The 31-foot-long SAFE Boat operated by the SDHP is also a planing vessel, but has different engine configuration, performance characteristics, and range of visibility than the SPC-LE.

speed range, that is, by traveling above and below this range as circumstances and conditions warranted.

1.13.2 Design Standards

The American Boat and Yacht Council (ABYC) has published *ABYC Standards for Small Craft* since 1954. Compliance with these standards is not required by regulation, but the standards are widely used by small craft manufacturers. DHS, in its contract with SAFE Boat, required that the SPC-LE meet applicable ABYC standards. The Coast Guard's contract with SAFE Boat said "unless otherwise specified, construction of the SPC-LE and installation of all equipment and systems shall be in accordance with ... ABYC standards."

One of the standards ABYC established was visibility standard, H-1 – Field of Vision from the Helm Position, a design standard for vessels less than 79 feet in length.⁵³ The purpose of this standard was to "minimize obstructions in the field of vision from the helm station(s)." The H-1 standard required visibility to be determined in a range of eye heights, from seated and standing positions. (See Appendix D for more information on the H-1 visibility standard.) The H-1 standard consists of horizontal and vertical components that comprise the range of visibility across the unobstructed vertical and horizontal fields of view.

NTSB investigators requested Coast Guard assistance in verifying that the SPC-LEs met the ABYC H-1 visibility standard. The Coast Guard responded that it had not conducted any first article testing⁵⁴ of the SPC-LEs because the vessel "was a proven capability which had been in use by Customs and Border Protection" and did not confirm whether the vessel complied with the H-1 standard. NTSB investigators also requested that SAFE Boat confirm that the SPC-LE met the ABYC H-1 visibility standard. SAFE Boat responded that the vessel complied with the standard and produced documentation to that effect.

1.14 Tests and Research

1.14.1 ABYC Visibility Testing

The NTSB contracted with ABYC to test whether the SPC-LE met the H-1 visibility standard. Because the *CG 33118* was impounded, another SPC-LE was used in the testing on San Diego Bay under NTSB supervision. ABYC conducted underway testing to determine the vessel's highest trim angle. This was done by recording trim angles, engine rpm, and speed throughout the vessel's operating range. The highest trim angle, outside of the transition zone,⁵⁵

⁵³ This report refers to the ABYC H-1 visibility standard dated July 2000.

⁵⁴ First article testing includes inspection and testing to ensure that a product's characteristics conform to drawings or specifications.

⁵⁵ The H-1 standard specifically excludes the high trim angles that occur during the transition zone, that is, between the displacement and planing modes.

occurred at about 3000 rpm, corresponding to a speed of about 19 knots. This trim angle corresponded to the end of the transition zone and the start of the planing mode.⁵⁶

ABYC subsequently tested the vessel on shore by positioning a trailered SPC-LE at the various trim angles that had been recorded while under way, and noting if a target point located four boat lengths from the bow⁵⁷ (135 feet) could be seen from specific eye positions.

ABYC determined that the SPC-LE failed to meet the H-1 visibility standard for the following reasons:

1. The horizontal 15-degree clear sector to port is obstructed by the center cabin structure at the standing low eye height position.
2. The horizontal 15-degree clear sector in the standing high eye position is obstructed from port to starboard.
3. The standing low eye (3.5 degrees maximum) and standing high eye (5.5 degrees maximum) positions cannot view the target at the maximum running angle of 6.5 degrees.
4. The port forward corner of the cabin structure does not allow normal movements of the operator's head to permit unobstructed visibility.
5. Controls for steering, shift, throttle, and trim were not positioned so that operator hand contact can be maintained during use in the seated position.⁵⁸

1.14.2 Forward Line of Sight—NTSB Comparison Study

NTSB investigators examined the vertical forward field of view from the two front-seat positions of the SPC-LE using input from the ABYC testing, Coast Guard Investigative Service underway testing video, and SPC-LE drawings. Investigators chose these positions because the starboard forward seat is manned by the coxswain, and the port forward seat is required to be manned another crewmember. The assessment considered both front-seat positions to be similar in configuration. Investigators used the approximate eye heights of the *CG 33118* coxswain, who

⁵⁶ The following table summarizes the recorded data from the on-water testing, correlating the approximate outboard engine rpm, boat speed, and boat trim angle to the SPC-LE's travel mode:

Mode	Displacement	Semi-Displacement	Planing
Outboard Engine (rpm)	0–2000	2000–3000	3000–5250+
Speed (knots)	0–8.4	8.4–19.2	19.2–43.7+
Boat Trim (degrees)	1.2–5.0	5.0–unknown	6.5–2.0

⁵⁷ Established in the H-1 design standard.

⁵⁸ The outboard engine throttle control levers on the tested SPC-LE were similar in dimension and location to the levers on the *CG 33118*; however, they were not the same type of control levers as on the *CG 33118*. The crew of the tested SPC-LE stated that the lever style on the tested vessel was the latest model fitted to SPC-LEs.

was 6'1" tall, and the boatswain's mate, who was 5'5" tall, to determine their sight lines to the surface of the water and the Sea Ray's all-around light and its hull, at different speeds.

At a vessel speed of 5 to 7 knots, crewmembers with eye heights of either the coxswain or the boatswain's mate would have had unobstructed sight lines to the Sea Ray's all-around light, and these sight lines would have met H-1 criteria. At eye heights similar to that of the coxswain, the Sea Ray's hull would be completely visible until it was 58 feet or less from the bow. At eye heights similar to that of the boatswain's mate, the Sea Ray's hull would have been completely visible until it was 77 feet or less from the bow.

At the speed that produced the greatest trim angle (about 19 knots), SPC-LE operators with eye heights similar to the coxswain's would not have a sight line to the surface of the water that met H-1 criteria, but would still have an unobstructed view to the Sea Ray's all-around light. The Sea Ray's hull would be obstructed from 0 to 135 feet from the bow, partially obstructed from 135 to 432 feet from the bow, and completely visible at distances greater than 432 feet from the bow.

At the same speed, the sight line of crewmembers with eye heights similar to that of the boatswain's mate would not meet H-1 criteria, as those crewmembers would have had an obstructed sight line to the water the entire time; that is, the horizon would never be in view. This eye height would have an obstructed sight line to the Sea Ray's all-around light until the light came within 160 feet of the bow, at which point it would gradually become visible. However, the Sea Ray's hull would not be visible at any time to crewmembers with this eye height.

The forward sight lines from both front-seat positions would improve at speeds above 19 knots. Near the SPC-LE's cruising speed of 35 knots, crewmembers with eye heights similar to either the coxswain or the boatswain's mate would have an unobstructed sight line to the Sea Ray's all-around light, and this sight line would have met the H-1 criteria. At this speed, the Sea Ray's hull would be completely visible to crewmembers with eye heights of the coxswain until the hull was less than 85 feet from the bow, and completely visible to crewmembers with eye heights similar to the boatswain's mate's until the hull was less than 121 feet from the bow.

1.14.3 SPC-LE Engine rpm/Speed Determinations

NTSB investigators were unable to obtain documentation of SPC-LE boat speeds at various outboard engine rpms with triple 300-hp engines. The data existed only for the SPC-LE as originally configured with triple 275-hp engines. To obtain the data, after completion of ABYC visibility testing, NTSB investigators recorded vessel speeds at particular engine rpms. The engine speeds recorded for engine rpms above the transition zone (i.e., in planing mode) are as follows:

SPC-LE with Triple 300-hp Engines	
Engine rpm	Speed in Knots
3000	19.2
3250	22.0
3500	25.9
3750	29.0
4100	33.0
4500	34.5
5000	39.2
5250	43.7

1.14.4 Video Study

NTSB investigators obtained witness video of the *CG 33118* operating in San Diego Bay prior to the accident. One video showed the vessel traveling southbound in the bay prior to meeting the cutter *Haddock*, and another showed the *CG 33118* on the leg prior to the accident, traveling from the northern end of Shelter Island eastward along Harbor Island.

The latter eastbound video consisted of 12 seconds of footage of the *CG 33118*, filmed by a witness on board a sailboat a few minutes before the collision. The sailboat was positioned about 460 yards south of the west end of Harbor Island and was estimated at one point to be about 66 yards from the passing *CG 33118*. The witness filmed in a sweeping motion from southwest to northeast. The footage captured the *CG 33118* during the vessel's eastbound transit on the bay when crewmembers were searching for the grounded Catalina along the south shore of Harbor Island. Shortly after this portion of the video was recorded, the *CG 33118* reversed its course to a west-northwesterly heading before the collision occurred. None of the west-northwesterly leg was captured by the video; however, the camera did capture the sound of the collision and filmed the area of the accident immediately after the collision. The video was filmed about 190 yards from the collision site.

Using fixed reference points in the background of the video, NTSB investigators calculated the speed at which the *CG 33118* was traveling during the earlier eastbound transit. Investigators determined that the *CG 33118* was traveling at about 42 knots⁵⁹ during a portion of the eastbound transit.

1.14.5 Audio Study of *CG 33118* Speed

NTSB investigators used audio tracks of the recording described in the previous section to conduct a sound spectrum study as an additional determinant of the speed of the *CG 33118*. The results indicated that, during the eastbound leg of the *CG 33118*, its engine rpm reached 5450 to 5550. This rpm corresponds to an estimated speed of 44–45 knots in accordance with the speed-versus-rpm graphs NTSB investigators developed during underway testing of an SPC-LE.

⁵⁹ The calculated average speed on a portion of the leg was 41.74 knots, with a +/-3.4 knot range of uncertainty.

1.15 Other Information

1.15.1 Nighttime Visual Perception

Because of statements from *CG 33118* crewmembers that they did not see the Sea Ray leading up to the accident, *CG 33118* investigators considered nighttime visual factors including the contrast of the Sea Ray's hull with the surface of the bay, the visibility and conspicuity of the Sea Ray's navigation lights, and the effect of the lights with regard to the visual angle to determine what effect, if any, these factors may have had on the crew's ability to see the Sea Ray.

During the day, people can visually distinguish objects that differ in brightness, color, pattern, and shading, but at night they rely on contrast to differentiate an object from its background. An object must be sufficiently brighter or darker than its background to be visible at night. Visibility of a lighted object, one researcher notes, normally refers to its intensity and depends on properties such as its luminance or brightness, color, size, and shape.⁶⁰ By comparison, an object's conspicuity also depends on these properties, but is relative to those of objects in the perceiver's field of vision. At night, a bright object that may be visible if viewed against a dark background will be inconspicuous or invisible if viewed against a background containing other, similar lights in the visual field. Therefore, at night, a lit object can be visible but not conspicuous if other lit objects are nearby.

The Sea Ray had three navigation lights, red port and green starboard lights mounted forward on its hull and an all-round white light mounted about 7 feet above the waterline at the centerline of the stern. The port and starboard lights faced forward in accordance with regulations and were shrouded from an astern view. Further, from an astern view, the Sea Ray's hull was unlit. Figure 9, shown earlier, depicts the waterway and background near the Sea Ray around the time of the collision. Both photos in Figure 9 indicate that lights with colors similar to the Sea Ray trio of navigation lights were present along the shore from the west to the north and on the water from other vessels, including some with extraneous holiday lighting. San Diego-based coxswains described San Diego Bay as a challenging nighttime visual environment because of background lighting.

Research also indicates that, at night, vehicle drivers use two additional cues, changes in the visual angle and changes in the size of the vehicle, to detect a vehicle ahead. The visual angle, which is formed by the angle of the paths of the two vehicles, will change as the angle of the paths changes. The perceived size of an object will change as a vehicle approaches another. The rate of changes in the visual angle, and the rate of change of the size of a stopped vehicle, provide operators with indications of the distance to an object and its speed relative to the speed of the operator's vehicle. An increasing visual angle indicates that the distance to the object ahead is decreasing. The smaller and more distant an object, the more diminished the ability of an operator to judge its distance and speed. Because the angle of the *CG 33118* and the Sea Ray was relatively constant, it did not change from the perspective of the *CG 33118* crew. Only the

⁶⁰ Wertheim, A. H. (2010). Visual conspicuity: A new simple standard, its reliability, validity, and applicability. *Ergonomics* 53, 421–442.

size of the Sea Ray's all-around light would have changed as the *CG 33118* approached the vessel.

1.15.2 Coast Guard AIS Policy

The *CG 33118* was outfitted with AIS, and the transponder was located above the helm console. In standard mode, AIS units on SPC-LEs broadcast a vessel's name, course, speed, latitudinal and longitudinal position, AIS identification number, and the vessel's dimensions. The unit provides AIS capabilities through three modes of operation. Coast Guard AIS policy guidance, issued in August 2008 by the admiral in charge of the Eleventh Coast Guard District, stated the following with respect to the three AIS modes:

- Standard mode—The unit will perform similarly to standard commercial shipboard AIS units, broadcasting the vessel's position and information to all other AIS receivers within VHF range. This mode is recommended for increased navigation safety and overt operations.
- Disabled mode—The unit will not transmit data at all. This mode is recommended for increased operations security and covert operations.
- Restricted mode—The unit will transmit encrypted AIS data that will be available only for friendly or blue force⁶¹ units with similar encryption capabilities. This mode is recommended as the default setting for boats with AIS units.

In all modes, the unit is able to receive, monitor, and display both encrypted and unencrypted AIS data from other AIS-equipped vessels.

The August 2008 AIS policy guidance also sought to “standardize the District-wide use of ... AIS and to enhance command centers’ common operating picture.” The policy guidance also stated that coxswains were allowed to switch modes at their discretion.

1.15.3 AIS Operation on the *CG 33118*

The *CG 33118* boat engineer told NTSB investigators that coxswains usually activated the AIS, and he believed that the AIS on board the *CG 33118* was operating on the evening of the collision. He also stated that the JHOC often notified Coast Guard vessels on departure that their AIS signals were displayed on the JHOC screens, but he was unsure if this occurred that evening. After the accident, NTSB investigators reviewed the AIS history plots for San Diego Bay that were recorded around the time of the collision. Although the JHOC AIS recording showed the *Haddock* and several large commercial vessels, it did not display any *CG 33118* AIS data.

After the accident NTSB investigators oversaw the testing of the *CG 33118*'s AIS. The tests were conducted in the enclosed Station San Diego helicopter hanger. The results revealed

⁶¹ Blue force tracking is used by law enforcement and military organizations to denote a GPS-enabled system that allows blue force command centers to locate and monitor AIS-equipped military assets, both friendly and hostile, and general AIS-equipped traffic in the area.

that latitude and longitude coordinates were not displayed on the AIS data screen, nor did the vessel's position register in the JHOC in either restricted or standard modes.

The JHOC watchstander at the time of the accident told NTSB investigators that he normally monitors the AIS of the small boats, but he said that when the *CG 33118* was under way, he did not notice that the *CG 33118* was not transmitting its AIS data. He said that after the accident occurred, he did not have a chance to follow up on whether the *CG 33118* had been transmitting AIS data. He would routinely note vessels not transmitting AIS data and then call their coxswains to tell them to activate their AIS units. He also noted that on some occasions when an AIS was not transmitting data, the JHOC would allow the vessel to continue its patrol.

1.15.4 *Thriller 09* and *CG 25689* Collision

On the night of December 5, 2009, at 2028 eastern standard time, the 25-foot Coast Guard small boat *CG 25689* and the small passenger vessel *Thriller 09* collided in Charleston Harbor, South Carolina.⁶² Before the accident, the *CG 25689* had been providing security escort service to a commercial ship that was outbound to sea. At the time of the accident, the *CG 25689* had completed its escort and was returning to its station. The *Thriller 09* was on a 1-hour sightseeing cruise in Charleston Harbor.

On board the *CG 25689* were three crewmembers; on board the *Thriller 09* were two crewmembers and 22 passengers. As a result of the accident, six passengers on the *Thriller 09* sought and received medical treatment for injuries. No crewmembers on the *CG 25689* or the *Thriller 09* were injured.

1.15.5 Cell Phone Use

Following the accident, the NTSB obtained records for the five *CG 33118* crewmembers' personal cellular telephones to determine what cell phone activity, if any, took place after the time the *CG 33118* got under way about 1723. The records indicated that the coxswain made a 2-minute call at 1724, but neither received nor sent text messages. The boatswain's mate in the forward port seat received a text message at 1742 (about 2 minutes before the collision) but did not send any herself, and she did not place or receive calls. The OOD, seated in the aft port seat, made a 9-second call at 1726 and a 7-second call at 1726. He sent a text message at 1727. The boat engineer, seated in the starboard aft seat, did not receive or make phone calls while under way. His text message activity could not be determined.⁶³

⁶² *Collision between USGC boat CG 25689 and passenger vessel Thriller 09, 12/5/2009, Charleston, SC*, Marine Accident Brief NTSB/MAB-11/02 (Washington, DC: National Transportation Safety Board, 2011).

⁶³ The boat engineer's wireless provider's information regarding text message activity did not allow investigators to determine the times at which the activity occurred.

1.15.6 Previous Safety Recommendations

In August 2010, the NTSB issued two safety recommendations to the Coast Guard with respect to cellular phone use:

Develop and implement national and local policies that address the use of cellular telephones and other wireless devices aboard U.S. Coast Guard vessels. (M-10-2)

Issue a safety advisory to the maritime industry that (1) promotes awareness of the risk posed by the use of cellular telephones and other wireless devices while operating vessels and (2) encourages the voluntary development of operational policies to address the risk. (M-10-3)

The recommendations were based in part on the *CG 33118* accident but primarily on the December 5, 2009, collision in Charleston. Cellular telephone records revealed that crewmembers on both Coast Guard vessels had been using cellular telephones to engage in text messaging or personal conversations near the time of the accident. In November 2010, the Coast Guard responded to the NTSB and indicated it concurred with both recommendations. In response to M-10-2, the Coast Guard stated that in July 2010 it established a policy mandating that crewmembers may use cellular telephones or texting devices on Coast Guard small boats, but only when authorized by the coxswain. The Coast Guard further stated that at no time was a Coast Guard vessel operator to use a cellular telephone or texting device for nonoperational purposes. The new policy was to be added to the Coast Guard's Boat Operations and Training Manual in the subsequent revision of the manual in 2011.

In response to Safety Recommendation M-10-3, the Coast Guard issued a safety advisory (01-10) in October 2010 that addressed distractions due to the use of cellular telephones and wireless devices. The Coast Guard added that it would work with the National Boating Safety Advisory Council to raise awareness of this issue with the recreational boating community. As a result of the Coast Guard's response and action, the NTSB in November 2010 classified Safety Recommendation M-10-2 as "Open—Acceptable Response" and M-10-3 as "Closed—Acceptable Action."

On June 21, 2011, the NTSB adopted further recommendations concerning cell phone use following its investigation of the 2010 collision of the tugboat/barge *Caribbean Sea/The Resource* with the amphibious passenger vehicle *DUKW 34*, in Philadelphia, Pennsylvania. The NTSB recommended that the Coast Guard

- Develop and implement an investigative protocol that directs its investigation officers to routinely check for nonoperational use of cell phones and other wireless electronic devices by on-duty crewmembers in safety-critical positions involved in marine accidents. (M-11-002)
- Revise its commercial vessel accident database (MISLE) to maintain a record of nonoperational use of cell phones and other wireless electronic devices by on-duty

crewmembers in safety-critical positions when such use is causal or contributory to marine accidents. (M-11-003)

- Regulate and enforce the restriction on nonoperational use of cell phones and other wireless electronic devices by on-duty crewmembers in safety-critical positions so that such use does not affect vessel operational safety. (M-11-004)
- Develop regulations governing nonoperational use of cell phones and other wireless electronic devices by on-duty crewmembers in safety-critical positions, and should continue its outreach program of information and education to the maritime industry on this issue. (M-11-005)

2 Analysis

2.1 General

The analysis first identifies factors that can be readily eliminated as causal or contributory to the accident, followed by a summary of the accident sequence. It then discusses safety issues identified in the accident investigation:

- Speed of the *CG 33118*
- Coast Guard oversight of small boat operations
- SPC-LE forward visibility
- Coast Guard monitoring of small boat operational data
- Coast Guard use of personal cell phones under way

2.2 Exclusions

At the time of the accident, the winds and sea were calm and visibility was good. The *CG 33118* crew and the Sea Ray operator were tested after the accident for the presence of alcohol and illegal drugs, and all results were negative. Both vessels were examined after the accident and found to have been free of preexisting issues that would have compromised their seaworthiness or operational capabilities. The Sea Ray's all-around light bulb was examined after the accident and found to have shown damage consistent with its being illuminated at the time of impact. The NTSB therefore concludes that weather, illegal drugs and alcohol, and the mechanical condition of both vessels were not factors in this accident.

Three of the five *CG 33118* crewmembers declined requests of NTSB investigators to be interviewed. Neither of the two crewmembers NTSB investigators interviewed—the boat engineer and the crewmember-in-training—was directly involved in navigating the *CG 33118*, and they did not sit in the front of the vessel where they could have played a substantial role in its operation. The boat engineer did not recall his sleep schedule in the days preceding the accident, but he reported going to sleep at 0300 and arising at 0630 on the day of the accident, for a total of 3.5 hours of sleep. This amount would, at best, lead to an acute sleep loss, which has been found to degrade performance.⁶⁴ The boat engineer reported taking a nap of unknown duration in the afternoon on the day of the accident; however, even if he slept well during the nap, the amount and quality of sleep would have been unlikely to compensate for the night's sleep loss because of the effects of his circadian sleep cycle. In any event, his role in the operation of the vessel was, as noted, minor. The crewmember-in-training estimated that, based on his typical rest schedule, he slept about 8.5 hours per day in the days before the accident. However, because the majority of *CG 33118* crew members declined to be interviewed by the NTSB, insufficient information was available to evaluate the role of fatigue in this accident.

⁶⁴ Mallis, M. M., Banks, S., and Dinges, D. D. (2010). Aircrew fatigue, sleep need, and circadian rhythmicity. In E. Salas and D. Maurino (Eds.) *Human Factors in Aviation* (2nd Ed. pp. 401-436). Burlington, MA: Academic Press.

2.3 The Accident

The Coast Guard SPC-LE vessel *CG 33118* departed Coast Guard Station San Diego at 1723 on December 20, 2009. The five crewmembers had no specific assignment except to patrol San Diego Bay during the Parade of Lights and assist other Coast Guard vessels as necessary. After departing the station, the crew coordinated with the crew of the Coast Guard cutter *Haddock*, the lead vessel in the Parade of Lights, and informed its commanding officer that the *CG 33118* crewmembers were available to provide assistance as needed.

After hearing a MARB about a grounded sailboat, the *CG 33118* crew obtained permission from the JHOC to respond. The crew initially searched for the sailboat along the south shore of Harbor Island. When the crewmembers could not locate it, they communicated with JHOC personnel and were redirected to the vessel's correct location, Harbor Island's West Basin. About three-quarters of a mile after the *CG 33118* crew turned the SPC-LE to travel to the second location, it collided with the *Sea Ray* recreational boat.

Witnesses described the *CG 33118*'s course as constant and at the same approximate west to northwest heading as the *Sea Ray* ahead of it. The physical evidence of the collision shows that the bow of the *CG 33118* struck the stern of the *Sea Ray* at an angle of about 11 degrees to starboard, an angle consistent with the *Sea Ray* operator's stated attempt, immediately before impact, to accelerate and turn his boat to the right to avoid being struck by the *CG 33118*.

2.3.1 *CG 33118* Operating Speed

The speed of the *CG 33118* directly affected the amount of time in which the crewmembers could have taken action to avoid the accident once they detected the *Sea Ray*; specifically, the time available for the coxswain and the crew to detect, perceive, and then avoid the *Sea Ray*. At the same time, vessel speed has a direct relationship to any vessel damage or personal injury that would be sustained in a collision with another vessel. NTSB investigators sought to determine why the *CG 33118* crew operated the vessel at the speed they did, given the prevailing circumstances and conditions.

The coxswain told SDHP that the *CG 33118* was traveling at 3000 rpm or about 19 knots at the time of the collision. Another crewmember estimated that the vessel was traveling 20 to 25 knots. Witnesses stated that the *CG 33118* was planing, corresponding to a minimum speed of 19 knots at the time of the accident, and estimated its speed as 20–30 knots. They also said that the vessel's speed on the accident leg was about that of the previous eastbound leg. The NTSB analysis of witness video of the *CG 33118* determined the vessel's speed to be about 42 knots while it was traveling east to the first reported location of the grounded sailboat, nearly full throttle, about 5000 rpm, a speed that audio analysis corroborated. If the accident leg speed was as high as the eastbound leg speed, as witnesses consistently attested, the speed on the collision leg could have been as high as 42 knots. Because of the absence of data on the accident leg, a precise determination of the speed and track of the *CG 33118* at the moment of collision could not be obtained. Nevertheless, operating the *CG 33118* at any speed above 8 knots (the vessel's approximate maximum displacement speed) was unsafe for the prevailing conditions. NTSB concludes that the *CG 33118* was planing, that is, traveling at least 19 knots, at the time of the

collision, considerably faster than a safe speed of 8 knots or lower under the prevailing conditions.

2.3.2 Marine Assistance Radio Broadcast

Coxswains must evaluate and determine the commensurate response for any assistance or distress call. The accident occurred while the *CG 33118* was actively responding to a MARB for a grounded sailboat. In accordance with its policy the Coast Guard issues MARBs on behalf of boaters that are requesting assistance, but are not in distress. Although the grounding location was originally conveyed incorrectly to the *CG 33118*, both the original and corrected grounding locations were in a protected harbor environment with fair weather conditions. Further, the JHOC watchstander clearly conveyed to the *CG 33118* that the sailboat was not in distress and there was no indication that the grounded boater was in any danger. Therefore the NTSB concludes that the vessel grounding to which the *CG 33118* responded was not an emergency, and did not necessitate a high-speed response that reached 42 knots at one point.

2.3.3 Traffic Density

Because of the Parade of Lights, considerably more vessels were on the bay that night than virtually any other night. The route of the *CG 33118* in response to the MARB was documented by witness and crew statements and by witness video. The *CG 33118* left station San Diego and met the *Haddock* near the north end of Shelter Island. In response to the MARB, the *CG 33118* initially headed to the northeast in an arc congruent to but south of the parade route. The eastbound leg passed close to the eventual accident site. This track allowed the crew to see the vessels in the vicinity of the parade route near the West Basin inlet, which would have made them cognizant of the heavy vessel density in the area. Further, the two crewmembers that the NTSB interviewed both commented on the greater than usual number of boats on the Bay that night. The NTSB therefore concludes that the *CG 33118* coxswain and crew were aware of the heavy vessel density in the area.

2.3.4 Safe Speed

Inland navigation rules obligate all mariners to operate their vessels at safe speeds “so they can take proper and effective action to avoid collision.” The rules assign mariners the responsibility to correctly interpret and apply navigational principles and practices, given the conditions and circumstances. The NTSB examined the prevailing conditions and circumstances to determine how the coxswain should have considered them in operating the *CG 33118*. These included darkness, background lights, the lights of the vessels in the area, the vessel traffic density, and the effects of the *CG 33118*’s wake.

Station San Diego Boat Piloting and Navigation Standards state that “special consideration must be given to the fact that background lights on shore will make the identification of vessel traffic more difficult.” Station San Diego coxswains told NTSB investigators that they were aware of the effects of the bay’s background lighting on their ability to detect vessels at night. Investigators examined the approximate route of the *CG 33118* on the

accident leg and noted that extensive background lighting spanned across the field of view of the *CG 33118* crew as they overtook the *Sea Ray*.

In addition to the effects of background lighting, the coxswain also needed to consider the effects of the density of vessels in the area. Over 80 boats participated in the parade, and there were hundreds of spectator boats, ranging from small dinghies, kayaks, and canoes (some unlighted) to large yachts and commercial vessels, congregated along the parade route, creating higher than normal vessel traffic, particularly in the area near the West Basin inlet.

The wake created by the *CG 33118* needed to be considered as well. A boat's wake can be hazardous, especially to smaller vessels. It can rock and potentially swamp or capsize other boats, and passengers may be thrown off balance or overboard. Where local conditions warrant, "no wake" areas are designated in many waterways as a means to protect other vessels. The *CG 33118* would have produced a wake at the speeds at which it was estimated to have been operated, endangering smaller vessels present at the event.

On the accident leg, the coxswain was operating the *CG 33118* at planing speed, which was at least 19 knots and possibly as high as 42 knots. He operated the vessel at 42 knots just minutes earlier on the preceding leg. Station San Diego instructions specified that SPC-LE cruising speed should not exceed 4200 rpm, which is equivalent to a speed of about 35 knots. The *CG 33118* crew was responding to a soft grounding, a nonemergency that did not warrant operating at such speeds. Given the inland navigation rules and Station San Diego speed guidance, the *CG 33118* coxswain and crew should have considered nighttime visibility limitations, San Diego Bay background lighting, and traffic density in determining safe vessel operating speed. In addition, crews should have considered wake effects of vessel speed. As noted previously, operating the *CG 33118* at any speed above 8 knots (the vessel's approximate maximum displacement speed) was unsafe for the prevailing conditions. Therefore, the NTSB concludes that the coxswain's operating the *CG 33118* at any planing speed was unsafe for the prevailing conditions and circumstances of darkness, background lighting, and high vessel density in the parade area.

2.3.5 Visual Perception and Conspicuity

Although the NTSB could not determine the precise point at which *CG 33118* crewmembers could have detected the *Sea Ray* immediately in front of them, investigators attempted to determine why the crew did not avoid striking the *Sea Ray*. The vessel was equipped with a functioning radar; however, the only crewmembers consenting to be interviewed were not involved in navigating the vessel and were unable to verify whether the radar was used on the night of the accident. For the crew to visually "see" the *Sea Ray*, they would need to detect it, perceive it as a boat, and then accurately interpret the boat's distance and relative speed.

In addition, given the cloud layer, the ambient level of illumination was relatively low. As a result, the *Sea Ray*'s hull lacked contrast with the surface of the bay.

The *Sea Ray*'s navigation lights were determined to be illuminated in accordance with applicable regulations. However, the considerable background lights around San Diego Bay

would have lessened the visual cues available to the *CG 33118* crew by limiting the visibility and the conspicuity of the Sea Ray's all-around light against the background. This phenomenon was well known to Station San Diego personnel. Further exacerbating the effects of the background lighting were the brightly lit parade vessels along the eastern shore of Shelter Island that were moving northward into the *CG 33118* field of view. Compounding the difficulties of nighttime visual perception, the *CG 33118* and Sea Ray maintained similar headings for some distance before the accident. Given the *CG 33118*'s course—directly approaching the Sea Ray's stern—the boat's all-around light would have appeared fixed, with no lateral relative motion in the *CG 33118* crew's visual field. This lack of relative motion deprived the crew of another visual cue which would have assisted in differentiating the all-around light from the background lighting because people more readily detect changes in the visual field, that is, motion or flashing, than they do constancy. Because of the constant-heading, dead-astern approach path of the *CG 33118* to the Sea Ray, the crew's ability to detect the Sea Ray's all-around light was limited. Assuming that the crewmembers detected the all-around light, their ability to perceive that they were rapidly closing on the slow-moving boat in front of them would be limited because of the single-point nature, or small size, of the all-around light and its lack of contrast with the surroundings.

In sum, an operator must detect and identify an object, perceive the associated hazard, and then take effective action to avoid striking that object. Operating at a slower speed would have increased the amount of time available to the *CG 33118* crew to detect, perceive, and take action to avoid the collision. Therefore, the NTSB concludes that the continuous illumination of the Sea Ray's all-around light, the effects of the background lights that limited the conspicuity of the all-around light, and the similar headings of the two vessels coupled with the dead-astern approach by the *CG 33118* made it difficult for the crew to visually detect and perceive the Sea Ray; however, traveling at a slow speed would have compensated for these visual difficulties.

2.4 SPC-LE Forward Visibility

Vessel design standards, while fundamental, play but one role in vessel safety. Regardless of design standards, operator skill and judgment, as well as system safety factors, are all basic elements in overall safety. The NTSB did not investigate contractual matters between SAFE Boat and the Coast Guard, which accepted delivery of the vessels under its contract with SAFE Boat. The NTSB also did not investigate the suitability of the specifications, or adequacy of the standards, that the Coast Guard specified for the SPC-LEs.

The NTSB examined the forward visibility of the SPC-LE to determine if, absent nighttime visual perception factors, the boat's design had any impact on the ability of the crew to detect targets ahead. The purpose of the visibility study was to identify obstructions to forward visibility for the two *CG 33118* crewmembers in the forward seats, the operating conditions under which these obstructions were present, and the effects of these obstructions on the ability of the two crewmembers to see the Sea Ray. One of the ABYC small craft standards (ABYC H-1, Field of Vision from the Helm Position) pertains to forward visibility, which for the SPC-LE applied only to the coxswain's position. At the request of and under observation by NTSB investigators, ABYC tested the SPC-LE's compliance with the H-1 standard. This standard

divides forward visibility into horizontal and vertical fields of view. The SPC-LE did not meet all the horizontal visibility criteria of the H-1 standard. However, considering the dead-astern approach of the *CG 33118* to the Sea Ray, investigators determined that the horizontal range of visibility was likely not a factor in the crew's ability to see the Sea Ray immediately preceding the accident. The NTSB examined the effects, if any, of the SPC-LE's failure to meet vertical visibility criteria on the coxswain's ability to detect the Sea Ray from the helm position.

However, the NTSB encountered several difficulties in attempting to determine what the coxswain could have seen. The vessel's exact speed, and therefore trim angle, before striking the Sea Ray is unknown. Further, the coxswain's position during this period could not be precisely determined.

Nonetheless, the NTSB attempted to determine, within a range of vessel speeds, the point at which the coxswain may first have seen the Sea Ray. Assuming a known static coxswain position and the highest vessel running trim angle, that is, a speed at 3000 rpm or 19 knots, the results of the NTSB comparison study indicate that the coxswain's unobstructed sight line to the water did not meet the vertical distance criteria specified in the H-1 standard. At this speed, the coxswain would have seen a portion of the Sea Ray, including the all-around white light, until that vessel was about 135 feet forward of the *CG 33118*'s bow, at which point only the all-around white light would still have been visible. These circumstances illustrate a worst-case visibility scenario. The vessel's vertical forward visibility is most limited at its highest running trim angle.

In addition, the evidence indicates that at least one *CG 33118* crewmember reacted to the Sea Ray just before the collision, and the operator of the Sea Ray said he saw crewmembers in the cabin of the *CG 33118* just before impact. Thus, regardless of the H-1 visibility standards, the *CG 33118* coxswain should have been able to see at least a portion of the Sea Ray at some point before the collision.

Further, boat speed and nighttime visual perception factors may have played a larger role than vessel obstructions in limiting the ability of the coxswain to detect and perceive the Sea Ray in time to avoid the collision. Operators can reduce the extent to which obstructions impair visibility by changing speed (for instance, slowing below 8 knots), changing their eye positions, or both to suit operational circumstances. Forward sight lines progressively improve with higher speeds which decrease the trim angles. Slower speeds, specifically below the transition zone (or about 8 knots), also improve forward sight lines due to lower trim angles. Several SPC-LE coxswains stated they were aware that the bow obstructed forward visibility, at speeds in, and just above, the transition zone. They therefore avoided traveling in this range.

Although not required by the visibility standard, the Coast Guard requires that the forward port position be manned. Along with the coxswain's position, the forward port position affords the best forward visibility on the vessel. Therefore, NTSB investigators examined the sight line of the boatswain's mate, who was seated in that position on the night of the accident. The results of the NTSB study indicate that at the boat's highest running trim angle, the boatswain's mate, who was of average female height, would not have been able to see the surface of the water over the *CG 33118* bow or any part of the Sea Ray. In addition, she would

not have seen the Sea Ray's all-around light until the *CG 33118* bow was within 160 feet of it. At speeds below 8 knots, the crewmember would have had an unobstructed sight line to the Sea Ray until it was about 77 feet forward of the bow.

The importance of adequate visibility for coxswains and crew is self-evident. Without it, the safety of SPC-LE operations is compromised and the risk of collisions and allisions increases. The Coast Guard expects its boats to be operated by crewmembers of a wide range of heights. However, the evidence indicates that shorter operators may not be able to see the surface of the water directly forward of the SPC-LE while in its lower planing range. Therefore, the NTSB concludes that SPC-LEs have obstructions to forward visibility from the helm and the forward port positions, which increase risks if not properly addressed.

Investigators were unable to find evidence indicating that the Coast Guard was aware at the time of the accident that SPC-LEs had obstructions to forward vertical visibility at certain speeds. In July 2010, Station San Diego modified its navigation standards, stating that its SPC-LEs should not be operated "between 2000-3500 rpm's unless absolutely necessary" because of the bow rise in that rpm range. However, investigators found no evidence that any other Coast Guard stations with SPC-LEs have similarly revised their navigation standards. As a result, the Coast Guard may not be adequately mitigating the risks associated with SPC-LE operation. Unless crewmembers are aware of the vessel's forward visibility limitations, they may not take adequate steps to compensate for them. Therefore, the NTSB recommends that the Coast Guard develop and implement procedures for its SPC-LEs that allow crewmembers to compensate for obstructions affecting forward visibility from the helm and the forward port positions.

2.5 Sea Ray

The Sea Ray operator stated he was traveling at idle speed, and witness statements supported this. NTSB investigators determined that the Sea Ray's navigation lights were illuminated at the time of the accident and configured in accordance with applicable inland navigation rules. Therefore, the NTSB concludes that the Sea Ray operator was driving his vessel at a safe speed and manner for the prevailing conditions and circumstances.

Further, with the estimated speed of the *CG 33118* and its reported path, the Sea Ray operator could have done little to avoid being struck by the Coast Guard vessel. Although he attempted to steer his boat out of the path of the oncoming *CG 33118*, the time available to him to maneuver the boat was insufficient to avoid being struck. Therefore, the NTSB concludes that the *CG 33118*'s high speed and its astern path relative to the Sea Ray precluded the Sea Ray operator from taking effective action to avoid the collision.

2.6 Training and Oversight

Investigators examined Coast Guard training and oversight of its small boats and SPC-LE crews in San Diego to determine why the coxswain and the crew operated the *CG 33118* at high speed in the crowded conditions of the Parade of Lights on San Diego Bay.

2.6.1 SPC-LE Coxswain Training

Coast Guard coxswains at all stations were trained through standardized instructional methods. The candidate must complete numerous qualification tasks, demonstrate proficiency during a comprehensive check ride with an instructor, and pass an oral examination before a board comprising senior Coast Guard station command and operations personnel. Examination topics included situational judgment, rules of the road, piloting and navigation, and risk assessment. The Coast Guard emphasized successful completion of each requirement more than the time required to attain proficiency.

2.6.2 Oversight

The *CG 33118*'s speed exceeded Station San Diego's maximum recommended operating speed for SPC-LEs in San Diego Bay on the evening of the accident. While coxswains were permitted to exceed the 4200 rpm limit, or 35 knots, for operational necessity or hot pursuit, no operational need called for speeds as high as 42 knots on the night of the accident, especially given the crowded, dark conditions that prevailed. Coast Guard managers told investigators that its oversight provided sufficient information to determine whether crews followed policies and rules. However, the speed of the vessel on the night of the accident and the lack of objections by other *CG 33118* crewmembers, including the officer of the day, regarding its speed, raises questions about Coast Guard oversight. The disparity in the evidence and testimony suggest that Coast Guard management is unaware of or possibly tolerates such speeds.

Station navigation standards specifically call for reduced speed at night, "even when responding to a potential life threatening case." However, interviews with coxswains and crew indicated that they considered 4200 rpm to be a normal transit speed for the SPC-LE in the bay during the day and night. Station command appears to have accepted this speed as normal. Further, following the accident witnesses stated that Coast Guard boats often operated vessels at high speeds in the bay. While some Coast Guard high-speed operations observed may have been for valid reasons, the evidence suggests that high-speed operations were routine rather than isolated events. The NTSB would expect an effective oversight system to identify unsafe practices, including excessive speed, and take steps to address them. There is no evidence that this occurred.

Coast Guard crewmembers were trained to voice safety concerns to coxswains about how boats were operated. However, neither of the two crewmembers NTSB investigators interviewed after the accident reported that anyone on the *CG 33118* voiced objections about the speed at which the coxswain operated the vessel. The NTSB cannot determine the reasons why none of the crewmembers objected to the speed even though they were expected to speak up if they were concerned about the way the vessel was being operated. Further, Coast Guard personnel on board the *Haddock* who witnessed the *CG 33118* depart from alongside the cutter at high speed also did not indicate a concern with the vessel's speed. Moreover, a more senior coxswain was on board the *CG 33118*; he was higher in rank than the coxswain and functioning as officer of the day and therefore directly represented the station's senior management. The senior coxswain declined an NTSB request to be interviewed; therefore, investigators could not ask him whether he recognized the speed of the *CG 33118* as excessive. Regardless, based on

conditions in the bay that night, he should have recognized that the speed of the *CG 33118* was excessive, and he was responsible and obligated to inform the coxswain to maintain a safe speed. His not speaking up regarding the vessel's speed indicates that the senior coxswain was deficient in exercising his oversight role and may have regarded the speed as acceptable.

In 2002, the NTSB investigated a collision in Biscayne Bay, Florida, between a Coast Guard Station Miami Beach patrol boat and a small passenger vessel, the *Bayside Blaster*. In that case, a Coast Guard coxswain was determined to have been operating at an excessive speed, at night, and in an area subject to background lighting. In both the Biscayne Bay and the San Diego accidents, Coast Guard station management was unaware of coxswains' excessive speeds for existing circumstances and conditions.

In the *Bayside Blaster* accident report, the NTSB commented, "Without some means of oversight, commanding officers cannot know that the speed limits are being followed or that other safety requirements are being met." Additionally, the NTSB concluded, the Coast Guard should "establish oversight procedures for use by commanding officers or officers-in-charge of Coast Guard stations to improve the safety of Coast Guard routine small boat operations." The NTSB added that oversight could be improved by regular direct observation of coxswain performance, and it issued Recommendations M-02-25 and M-02-26 to address the shortcomings it identified. The following year, NTSB classified both recommendations as "Closed—Acceptable Action."

Maximum authorized speed was apparently regarded as normal operating speed at Coast Guard Station Miami Beach during that time, prompting a 2002 Coast Guard Commandant statement to urge small boat force leaders to "impress upon all hands that throttles have more than two [stop and full] operational positions. The image of a young coastie zipping along at max throttle is becoming a stereotype, reflects poorly upon our professionalism, and encourages reckless behavior in our developing boat crews. This is a safety issue, an equipment issue and a leadership issue."

The Coast Guard concurred with the NTSB recommendations. It revised its Boat Readiness and Standardization Program Manual requiring continuous evaluation of the readiness of boats and crews. It recommended that readiness and standardization evaluations include assessment of performance in team coordination, risk management, and crew briefing and debriefing as part of standard boat operations. It used STAN and RFO evaluations to assess a unit's crew training program and underway exercise evaluation.

NTSB investigators examined the results of the January 2010 STAN assessment conducted shortly after the accident. Station San Diego SPC-LE coxswains performed poorly on portions of the written test, averaging a score of 58.6% on navigation rules. Coxswains on the station's other small boat also performed poorly on this section, averaging 62.5%. According to the STAN program manager, the station's command is responsible for addressing such shortcomings. Investigators requested documentation of actions taken in response to these findings. There were none. Lack of any remedial actions taken is not indicative of responsible oversight.

Although RFO and STAN team evaluations provided the Coast Guard with information about SPC-LE crew knowledge, techniques, and skills, they did not provide Station San Diego information about how coxswains and crewmembers were operating the vessels outside these controlled circumstances. RFO and STAN team evaluations provide snapshots in time of performance in controlled, predicted, and structured environments with oversight personnel constantly present, but provide no information to managers about how SPC-LE vessels were being operated day-to-day. Therefore, RFO and STAN team assessments provide an incomplete picture of how vessels are routinely being operated.

In sum, the investigation uncovered several areas in which Coast Guard Station San Diego oversight was deficient: the speed at which the *CG 33118* was operated on the night of the accident; the speeds at which SPC-LE vessels were routinely being operated at night; the silence of the *CG 33118* crewmembers regarding the speed; the limitations of RFO and STAN team evaluations; the lack of follow-up on STAN assessments; and, as is discussed below, the failure to ensure transmission of AIS data.

Without effective oversight, management cannot determine if policies and procedures are followed or other safety requirements are being met. Oversight of Station San Diego Coast Guard small boat operations could be improved by direct observation of coxswain performance and monitoring of AIS and other recordable operating data, among other means. Therefore the NTSB concludes that Station San Diego oversight of small boat operations was ineffective in ensuring compliance with established policies for safe operations.

Effective oversight requires an organization to maintain an ongoing awareness of how its personnel operate its equipment, so that rules are being adhered to and best practices followed. This involves problem recognition and implementation or modification of policies and procedures as needed. Without the necessary data and procedures needed to review and analyze operations, managers are limited in their ability to assess those policies, procedures, and risks. Current Station San Diego practices do not afford comprehensive oversight of small boat operations. Changes in oversight procedures should effectively address risks that small boat crews face. These risks include nighttime operations in areas where background light can interfere with visibility and in congested waterways. The circumstances of this accident call for the Coast Guard to implement oversight procedures that provide it with information about day-to-day small boat operations. Moreover, given the shortcomings identified in Station San Diego oversight, the NTSB is concerned that other Coast Guard small boat stations may also be unaware of the manner in which small boats are being operated. Therefore, the NTSB recommends that the Coast Guard examine its oversight of small boat operations to determine where local procedures are inadequate, implement procedures nationally and at each station (including Station San Diego) to provide continual, systematic, and thorough oversight information, and require action on information obtained to ensure that crewmembers are operating their vessels safely in all conditions and circumstances.

2.6.3 SPC-LE Speed Policies

Shortly after the *Bayside Blaster* accident, the Coast Guard updated its safety policies⁶⁵ to require commanding officers of Coast Guard stations to establish speed limits in specific areas of their AORs “that pose significant or environmental risk to boats.” In hindsight, the evidence suggests that the actions the Coast Guard took after that accident did not establish the policies it needed to ensure the safety of its vessel operations.

Station San Diego afforded coxswains broad authority to determine the speed at which to operate their vessels, although coxswains were expected to proceed at a safe speed at all times and were not to exceed 4200 rpm (about 35 knots) unless dictated by operational necessity, hot pursuit, or an emergency. The rpm limit appears to be related to fuel efficiency rather than to safe operation. San Diego coxswains told NTSB investigators this was the only parameter that restricted their boat speed and that it was not unusual to operate at night, in the bay, at 4200 rpm. After the accident, Station San Diego’s commanding officer issued verbal guidance restricting speeds in the bay, outside of the main shipping channel, to a “minimal” or idle speed. The NTSB concludes that at the time of the accident, the absence of Station San Diego speed restrictions for routine patrols at night allowed coxswains too much latitude in selecting patrol boat speed. Furthermore, the NTSB is concerned that other Coast Guard stations may lack speed restrictions for routine patrols in their areas of responsibility.

Although the NTSB supports Station San Diego’s attempt to improve safety by providing verbal speed guidance to its SPC-LE coxswains, such guidance can, over time, lose effectiveness. Providing written policy to small boat operators, on the other hand, serves as an official Coast Guard procedure for coxswains to follow. Over time, written policy retains its effectiveness to a greater extent than verbal guidance. Therefore, the NTSB recommends that the Coast Guard require each small boat station, including Station San Diego, to establish specific operating procedures governing small boat speeds that account for prevailing conditions and circumstances affecting the safety of small boat operations.

2.7 AIS Use

This investigation was hampered by the absence of exact speed, heading, and position data on the *CG 33118* at critical points during the transit. Although the *CG 33118* was equipped with AIS, which would have provided this information, no AIS data were available. Investigators determined possible reasons why the data were not recorded: crewmembers did not activate the unit; they activated the unit in a mode that did not transmit; or the AIS unit was not functioning properly at the time of the accident. However, the reason why AIS data were not recorded at the JHOC could not be determined.

Regardless of the reason, Coast Guard policy calls for small boats to operate their AIS in a transmitting mode when under way unless operational security needs dictate otherwise. Both Coast Guard headquarters and the Eleventh Coast Guard District’s AIS transmission policy identified “restricted mode” as the default setting for standard (small) boats. The fact that the

⁶⁵ Commandant Instruction (COMDTINST) 3530.2C, Coast Guard Navigation Standards Manual.

CG 33118 was operating on the night of the accident without its AIS transmitting, and that JHOC personnel did not address this omission, indicates that deficiencies exist in the application and enforcement of the Coast Guard's AIS policy. Therefore, the NTSB concludes that the Coast Guard failed to effectively ensure that its AIS policy was enforced in San Diego.

Coast Guard policy relied on coxswains to activate the AIS, and set it to the appropriate mode. However, no procedures were in place to ensure that the coxswain activated the AIS or that, if on, the AIS was actually transmitting. In San Diego, JHOC personnel were in the best position to carry out this function. On the night of the accident, the *CG 33118* crew checked in with the JHOC, as required, on getting under way. JHOC personnel should have noticed that the *CG 33118*'s AIS was not transmitting at that time. However, this verification did not take place, nor was it required to by any written policy or procedure. As a result, important vessel data from the *CG 33118* was not transmitted or recorded. The NTSB therefore recommends that the Coast Guard develop and implement procedures to ensure that its coxswains follow established AIS transmission policies.

2.8 Vessel Operations Monitoring

In addition to AIS, a wide array of technologies is used to navigate and operate vessels, including electronic chart displays and Global Positioning System (GPS) units. The NTSB recognizes the benefits of using all available data for operational and crew monitoring and oversight in addition to navigation.

An operational monitoring program might have helped to prevent this collision by enabling supervisors to track coxswains' underway practices that may have fallen outside established guidelines. However, no formal monitoring program was developed or used by the Coast Guard.

The Coast Guard would benefit from the review and monitoring of all these sources of available operational recorded data on its vessels. The NTSB recognized this in its investigation of the collision of the *CG 242513* and the *Bayside Blaster* when it commented, "Technological advances in transponder technology may provide an additional oversight tool if applied to station operations." Therefore, the NTSB concludes that systematic monitoring of all available operating data could assist Coast Guard small boat supervisors in objectively assessing how their vessels are operated, and periodic review of this information could enhance operational safety and oversight by aiding supervisors in detecting and correcting deviations from standard operating guidance and procedures. The NTSB therefore recommends that the Coast Guard establish a structured data monitoring program for its small boats that reviews all available data sources to identify deviation from established guidance and procedures.

2.9 Cell Phone Use

At the time of the accident the Coast Guard had no policy governing the use of cell phones and similar portable electronic devices by its crewmembers during vessel operations. However, all crew were responsible for performing lookout duties during small boat operations,

according to the Coast Guard's Boat Crew Seamanship Manual.⁶⁶ Coast Guard crewmembers also were trained to voice safety concerns or "speak up" if they noted an unsafe condition, such as operating at an unsafe speed or in an area of high boat traffic density. Yet, if crewmembers were engaged in using personal electronic devices during the trip, this distraction would have prevented them from executing these duties.

As noted, the NTSB obtained records from the *CG 33118* crewmembers' personal cell phone service providers and determined that activity was recorded for the coxswain, the boatswain, and the OOD (activity could not be determined for the engineer). The NTSB was troubled to learn that this activity included sending text messages approximately 15 minutes before the collision. The NTSB concludes from these records that *CG 33118* crewmembers used their personal cell phones for voice calls and text messaging while under way, distracting them from effectively performing their duties as lookouts.

Based on this accident, along with the *Thriller 09* accident in Charleston, South Carolina, the NTSB issued recommendation M-10-2 to the Coast Guard urging it to develop and implement policy to address the use of cell phones and other wireless devices by its crewmembers during vessel operations, as previously noted. The Coast Guard responded positively by issuing a policy restricting crew cell phone use during operation of its vessels to purposes related to those operations.

2.10 Emergency Response

Following the collision, the *CG 33118* crew quickly responded to the accident and cared for the most seriously injured passenger on the *Sea Ray*, the 8-year-old boy who had been seated near the center of the rear bench of the boat. The crew immediately removed him from the vessel and transported him to the nearby Harbor Island fuel dock, where he was taken to a nearby hospital. Other seriously injured passengers were transferred to local hospitals for treatment as a result of the prompt actions of the *Sea Tow*, good Samaritans on nearby recreational vessels, and shore side responders from San Diego Fire and Rescue. The NTSB therefore concludes that actions of the emergency response personnel following the collision were timely and effective.

⁶⁶ See section 1.12.5, Lookout Procedures.

3 Conclusions

3.1 Findings

1. Weather, illegal drugs and alcohol, and the mechanical condition of both vessels were not factors in this accident.
2. The vessel grounding to which the *CG 33118* responded was not an emergency and did not necessitate a high-speed response that reached 42 knots at one point.
3. The *CG 33118* was planing, that is, traveling at least 19 knots, at the time of the collision, considerably faster than a safe speed of 8 knots or lower under the prevailing conditions.
4. The *CG 33118* coxswain and crew were aware of the heavy vessel density in the area.
5. The coxswain's operating the *CG 33118* at any planing speed was unsafe for the prevailing conditions and circumstances of darkness, background lighting, and high vessel density in the parade area.
6. The continuous illumination of the *Sea Ray's* all-around light, the effects of the background lights that limited the conspicuity of the all-around light, and the similar headings of the two vessels coupled with the dead-astern approach by the *CG 33118* made it difficult for the crew to visually detect and perceive the *Sea Ray*; however, traveling at a slow speed would have compensated for these visual difficulties.
7. Special purpose craft – law enforcement (SPC-LE) vessels have obstructions to forward visibility from the helm and the forward port positions, which increase risks if not properly addressed.
8. The *Sea Ray* operator was driving his vessel at a safe speed and manner for the prevailing conditions and circumstances.
9. The *CG 33118's* high speed and its astern path relative to the *Sea Ray* precluded the *Sea Ray* operator from taking effective action to avoid the collision.
10. Station San Diego oversight of small boat operations was ineffective in ensuring compliance with established policies for safe operations.
11. At the time of the accident, the absence of Station San Diego speed restrictions for routine patrols at night allowed coxswains too much latitude in selecting patrol boat speed.
12. The Coast Guard failed to effectively ensure that its automatic identification system policy was enforced in San Diego.

13. Systematic monitoring of all available operating data could assist Coast Guard small boat supervisors in objectively assessing how their vessels are operated, and periodic review of this information could enhance operational safety and oversight by aiding supervisors in detecting and correcting deviations from standard operating guidance and procedures.
14. *CG 33118* crewmembers used their personal cell phones for voice calls and text messaging while under way, distracting them from effectively performing their duties as lookouts.
15. Actions of the emergency response personnel following the collision were timely and effective.

3.2 Probable Cause

The National Transportation Safety Board determines the probable cause of the collision between the *CG 33118* and the *Sea Ray* was the failure of the *CG 33118* crew to see and avoid the *Sea Ray* because of the excessive speed at which the coxswain operated the *CG 33118*, given the prevailing darkness, background lighting, and high vessel density, and the U.S. Coast Guard's lack of effective oversight of its small boat operations both nationally and at Coast Guard Station San Diego.

4 Recommendations

To the U.S. Coast Guard:

Develop and implement procedures for your special purpose craft – law enforcement that allow crewmembers to compensate for obstructions affecting forward visibility from the helm and the forward port positions. (M-11-8)

Examine your oversight of small boat operations to determine where local procedures are inadequate, implement procedures nationally and at each station (including Station San Diego) to provide continual, systematic, and thorough oversight information, and require action on information obtained to ensure that crewmembers are operating their vessels safely in all conditions and circumstances. (M-11-9)

Require each small boat station, including Station San Diego, to establish specific operating procedures governing small boat speeds that account for prevailing conditions and circumstances affecting the safety of small boat operations. (M-11-10)

Develop and implement procedures to ensure that your coxswains follow established automatic identification system transmission policies. (M-11-11)

Establish a structured data monitoring program for your small boats that reviews all available data sources to identify deviation from established guidance and procedures. (M-11-12)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

DEBORAH A.P. HERSMAN
Chairman

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Member

CHRISTOPHER A. HART
Vice Chairman

MARK R. ROSEKIND
Member

EARL F. WEENER
Member

Adopted: July 12, 2011

Appendixes

Appendix A

Investigation

The National Transportation Safety Board was notified of the accident by the Coast Guard National Command Center at 2157 eastern standard time on December 20, 2009. A four-member go-team launched at 1200 the following day and arrived on scene in San Diego at 1500 Pacific standard time. The launch team consisted of specialists in engineering, deck operations, and survival factors. On December 22, the team was joined by a representative from the NTSB's Transportation Disaster Assistance Division. Also joining the team was a Coast Guard investigator from Coast Guard headquarters' Office of Investigations and Analysis.

The investigators interviewed two crewmembers from the *CG 33118*, the operator and the passengers on the *Sea Ray*, and Coast Guard Sector San Diego supervisory personnel. After completing the interviews, documenting the vessel damage, and collecting documentation, the investigators concluded the on-scene investigation on December 25.

The NTSB investigated the accident under the authority of the Independent Safety Board Act of 1974, according to the Board's rules. The sole party to the investigation was the Coast Guard.

Appendix B

U.S. Coast Guard Inland Navigation, Steering and Sailing Rules, Rule 6, Safe Speed

Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.

In determining a safe speed the following factors shall be among those taken into account:

- (a) By all vessels:
 - (i) the state of visibility;
 - (ii) the traffic density including concentration of fishing vessels or any other vessels;
 - (iii) the maneuverability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions;
 - (iv) at night, the presence of background light such as from shore lights or from back scatter of her own lights;
 - (v) the state of wind, sea, and current, and the proximity of navigational hazards;
 - (vi) the draft in relation to the available depth of water.
- (b) Additionally, by vessels with operational radar:
 - (i) the characteristics, efficiency and limitations of the radar equipment;
 - (i) any constraints imposed by the radar range scale in use;
 - (ii) the effect on radar detection of the sea state, weather, and other sources of interference;
 - (iii) the possibility that small vessels, ice and other floating objects may not be detected by radar at an adequate range;
 - (iv) the number, location, and movement of vessels detected by radar; and
 - (v) the more exact assessment of the visibility that may be possible when radar is used to determine the range of vessels or other objects in the vicinity.

Appendix C

Letter from Commander, U.S. Coast Guard Sector San Diego, Concerning Verbal Speed Guidance



Commander
U.S. Coast Guard Sector

2710 N Harbor Dr
San Diego, CA
Staff Symbol: s
Phone: (619) 278-7201
Fax: (619) 278-7235
Email:

3505
May 20, 2011

Brian Curtis
Investigator-In-Charge
National Transportation Safety Board
Washington DC 20594

Dear Mr. Curtis

This letter is in response to your request for additional information regarding my verbal order on safe speed referenced in LCDR Schultz's January 21, 2010 interview. I issued this order as a reminder to our boat operators and their leaders that we are always in the public eye and that we need to be cognizant of the impression we may be leaving the public with when training and operating. This was not a new requirement, but a reminder.

My directive was not intended to impose speed restrictions. Coast Guard coxswains are highly trained and are provided tools to constantly evaluate the changing risks encountered in executing their missions, including determining safe speed. The Station's standing orders in effect at the time of the mishap clearly discuss that special consideration must be given to operating at night and in areas where background lighting could cause visual impairment, and also discuss the tendency of the SPC-LE to ride how high at certain speeds. The requirement to follow standing orders is made perfectly clear to Coxn's during training and continuously throughout their assignment. Unfortunately on the evening in question a well trained, qualified, and current Coxn failed to follow the written guidance provided in his standing orders with tragic consequences.

Safety of my crew and the public is my utmost priority. Recognition of the need to travel at safe speed was stressed specifically to station personnel by me on at least 8 specific occasions prior to the mishap. My email was a reminder of that important tenet to all of our boat operators.

I remain confident in my leaders and their coxswains' ability to safely conduct our missions while balancing risk and gain. I hope that this letter will assist with your understanding of my order and its intent. Please, feel free to contact me with any questions regarding this matter.

Sincerely,

A handwritten signature in black ink that reads "T. H. Farris".

T. H. FARRIS
Captain, U.S. Coast Guard

Appendix D

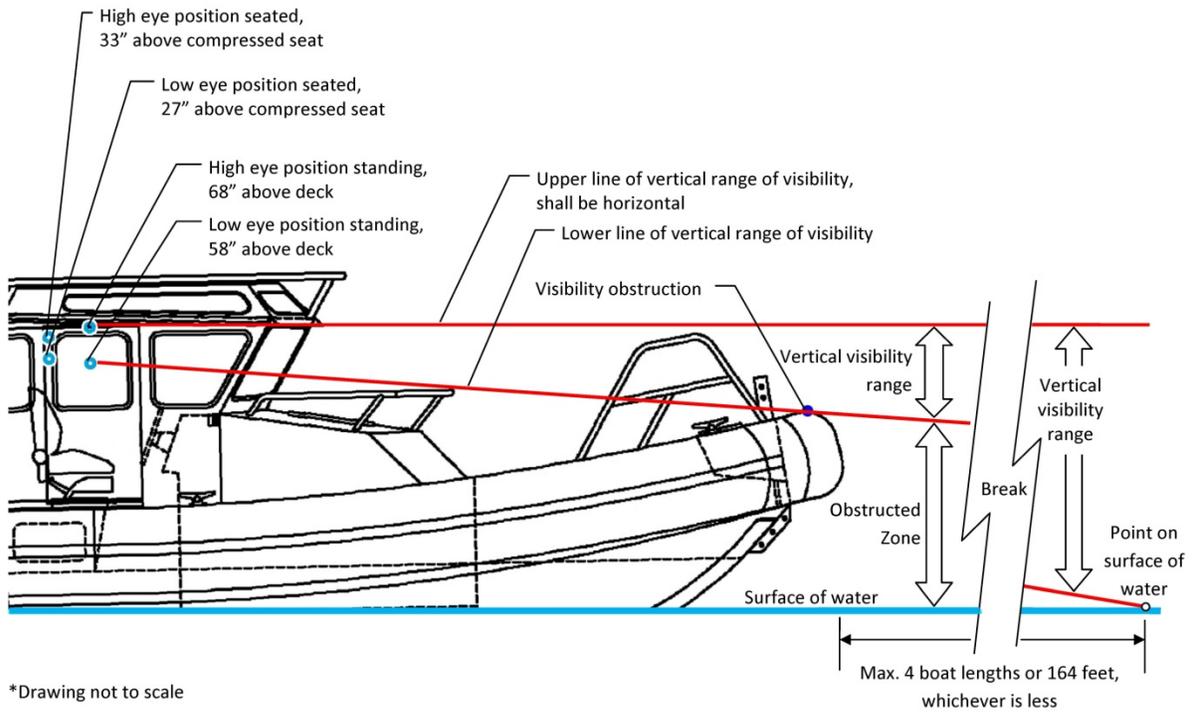
ABYC H-1 Visibility Standard

The purpose of the ABYC H-1 visibility standard is to provide guidance to minimize obstructions in the field of vision from the helm position. In part, the standard includes the following visibility criteria:

- Horizontal range looking forward: Shall have a 30-degree clear sector (15 degrees to port and starboard). Outside the clear sector, from 90 degrees to port and 112.5 degrees to starboard, obstructions shall be kept to a minimum so normal head movements will permit unobstructed visibility.
- Horizontal range looking aft: Must keep obstructions to a minimum.
- Vertical range looking forward, within the 30-degree clear horizontal section: Shall extend from a horizontal line from the high eye position to a line established between a point on the water four boat lengths or 164 feet, whichever is less, ahead of the boat and measured from the bow, through the highest point of lower obstructed visibility to the low eye position. [An NTSB-developed diagrammatic representation of the vertical range requirement is shown on the following page.]
- Vertical range outside the forward 30-degree clear sector (remaining 330 degrees): Similar to within the 30-degree clear sector forward, but measured from the gunwale.

The standard also states:

1. In order for this standard to be effective the boat must be operated in a reasonable and prudent manner.
2. Boats can be operated in a manner and at certain speeds causing trim and/or roll angles such that vision is obscured. This standard cannot assure that a boat can be operated without some loss of vision from the helm position while operating at high trim angles during the transition between displacement and planing mode.
3. This standard does not relieve the operator of the requirement to comply with the Rules of the Road.



Appendix E

USCG Shore-Based Boat Accident Data

Each year the Coast Guard publishes an Annual Afloat Safety Report containing data on mishaps for that year, and historical data from previous years. The report examines cutter mishaps and small boat mishaps separately. The Coast Guard provided investigators with the annual reports from FY01-FY10. There was no report created for FY06. Overall small boat mishap rates (Class A-D combined)* increased each year from 1999 to 2007. Since 2007, mishap rates have declined steadily, from about 118 per 100,000 operating hours to just fewer than 80 per 100,000 operating hours in FY10.

Mishap rates for Class A and B mishaps have remained steady for the last 10+ years. There was only one Class A mishap in FY10, the San Diego CG3318 accident. There were no Class B mishaps in FY10. In FY09 there were two Class B mishaps and no Class A. In FY08 there were no Class A or B mishaps. There was one of each in FY2007. Overall, the Class A and B mishap rates per 100,000 small boat operating hours are each less than 1 since 1999.

The SPC-LE's mishap rate per 100,000 hours has decreased each year since FY07, the first year data was available for the platform. In FY07 its mishap rate was around 120 per 100,000 hours. In FY10 its mishap rate was around 75 per 100,000 hours. In FY10, the SPC-LE had the 7th lowest rate of mishaps per 100,000 operating hours out of 17 small boat platforms. The most common types of mishaps were collisions, followed by groundings. The mishaps most often occurred during training, followed by search and rescue missions.