

Carbon Monoxide Follow-up Meeting

Miami, FL – IBEX Show
November 2, 2006

Minutes

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Sponsored by:

United States Coast Guard
Office of Boating Safety
Recreational Boating Product Assurance Division

Minutes prepared by:

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**United States Coast Guard (USCG)
Propeller Injury Avoidance/Carbon Monoxide (CO)
Update Meeting
Thursday, November 2, 2006
IBEX Miami, FL**

Richard Blackman began the meeting by commenting on the format of this meeting, propeller issues will have approximately 1 hour and 15 minutes while the carbon monoxide session will have 45 minutes. The attendance list for the combined meeting is attached as appendix A.

Mr. Blackman discussed the status of the USCG propeller injury mitigation strategies. Propeller guards and engine cut-off devices are among the devices the USCG is presently investigating. Action is in progress on a NBSAC recommendation for the USCG to issue a notice of proposed rulemaking on:

- a. Equipping some boats with an engine cut-off device
- b. Mandatory wear of the device when the boat is so equipped.

The second action at the USCG level deals with propeller guards. The USCG has asked the American Boat & Yacht Council to coordinate a study on the feasibility of propeller guard type devices to prevent accidents. In late spring 2006, the USCG gathered a team of recognized experts to begin formulating a testing protocol for a propeller guard. This is just one step in evaluating the suitability of a guard in preventing propeller injury. The others are human factors (e.g. can a guard cause more damage due to blunt trauma or can a limb or other body part get to the blades of the propeller through the proposed guard) and device durability and practicality (e.g. how does the device hold up over time and what are the maintenance issues associated with the installation).

Mr. Blackman introduced Robert MacNeill and John Adey who presented the current status of development of the protocol section of the guard study. The presentation is attached as appendix B.

There are 3 experts that the USCG has identified:
Robert MacNeill, International Marine Consulting Associates
Richard Akers, Small Craft Engineering, LLC
Clifford Goudey, Massachusetts Institute of Technology.

These experts have been coordinating on a testing protocol for a propeller guard based on:
Statistically identified high risk boat (16-18' open sterndrive)
Commercially available guard (full cage model)

The draft protocol was tested in September in Solomons, MD. The testing revealed the need for additional sensors (e.g. wheel position, GPS tracking) and testing a wider variety of guard devices to determine maneuvering parameters necessary to produce potentially unsafe behavior. The group will be meeting again before January to discuss the next round of testing to be undertaken by the Massachusetts Institute of Technology.

QUESTIONS:

Focus is to test existing product, why did the USCG pick that route, why not work on design?

ABYC presented their standards writing model which is to write performance based standards not design based. If an appropriate protocol can be devised, then any and all devices can be tested with a pass/fail result.

It does not sound like anyone with engine expertise is involved in the procedures; do you plan on looking into engine related issues?

These issues have been discussed and will be looked at. The USCG is looking at safety first. Data acquisition at this point is collecting engine data. As another aspect engine manufacturers will be brought in.

Is the assumption that it will be a people protector or are you just seeing if it will cause the boat to mishandle?

At this point in the project we are just looking at boat characteristics.

Noticed that you were using a full cage type prop guard is there any distinction?
Part of this project is defining what a guard is; will have to be defined in the human factors section.

Does the accident data differentiate between struck by propeller and struck by boat?

Yes, but the data is only as accurate as the reporting agency.

Has the group considered the increase in the surface area with the addition of the guard as opposed to just the propeller?

This will be addressed under the human factor area.

Mr. Blackman closed the presentation by stating that the USCG is not testing propeller guards. The USCG is developing a protocol to test guards. This testing may ultimately be done by an independent party or the device manufacturer.

Mr. Blackman introduced Phyllis Kopytko from Stop Propeller Injuries Now (SPIN). Ms. Kopytko's statement is attached as appendix C.

QUESTIONS:

Accidents don't just happen, they are created by unsafe act or unsafe condition, if it's an unsafe condition then we can address that, if it's an unsafe act then we need to focus holding people responsible to make people know that you have to be in command.

SPIN believes that education is only part but since the technology is available then we should be usable.

CARBON MONOXIDE UPDATE

Dan McCormick introduced Kiko Villalon, ANCON Marine Consultants and Alberto Garcia, NIOSH. Mr. McCormick discussed the ongoing project of carbon monoxide and express cruisers. Since becoming aware of an increase in carbon monoxide incidents with “express cruiser” style boats, both NIOSH and the USCG have been testing boats considering the migration of CO. This presentation surrounded a computer model that NIOSH has been working on.

CO

Model is a 30 footer beam of 10 feet with a typical canvas configuration
Domain (or environment) size is ten times greater than the dimensions of the boat.

Canopy creates eddies and a low pressure section behind the boat especially with canvas deployed and rear open for “fresh air”

Modeling has been done to date with no wind (air flow created by the boat moving through the water). This is due to it taking several days to run the simulation.

The simulation shows less than 20 seconds to fill up part of the cockpit of the boat with 100ppm CO.

With just the bimini top installed, no CO concentration of 100ppm or greater entered to boat, however in physical testing it was shown that higher levels were entering the boat.

Simulation in the cabin with the door open and canvas deployed leads to greater than 200 ppm concentrations, (with the test with door closed still showed between 15 and 50 ppm)

The work is available at www.cdc.gov/niosh/topics/coboating

NIOSH will be retesting Westerbeke CO Safe generator sets in November; some have over 4000 hours. NIOSH is trying to arrange with Kohler to do the same testing on their models.

The group tried some experiments with fans to create forced ventilation, results were medium to low impact on the CO levels.

Routing exhaust underwater shows that exhaust bubbles run much further aft before they surface. ANCON/NIOSH are working with Brunswick to use their patented exhaust in the next round of testing, and to investigate feasibility of retrofitting and underwater exhaust on existing boats.

QUESTIONS

Are there any drawings on the website on the Brunswick style exhaust?

No, it is a proprietary system

Did you run the boat with front and forward hatches open?

Yes, the boat was run with several configurations, this is contained in the NIOSH report of the actual testing this is only computer simulation at worst possible conditions.

Does the simulation assume a perfect seal in the canvas?

Yes, but NIOSH is aware that a perfect seal is not created however it is extremely difficult to model that.

California Air Resources Board UPDATE

John McKnight from NMMA discussed that one manufacturer is successfully using a catalyst on a propulsion engine; The catalyst engine is available right now in California, but by early next decade all boats may have catalysts.

**Accident Mitigation Meeting
Attendees
November 2, 2006
Appendix A**

Adriance	Bob	BoatUS	badriance@boatus.com
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**Accident Mitigation Meeting
Attendees
November 2, 2006
Appendix A**

		& Howlett	
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USCG Propeller Accident Mitigation Evaluation

Protection Devices

John Adey, ABYC

Bob MacNeill, IMCA

Initial Thoughts

- Marine Technology Society Report 1997:
 - Identify Characteristics
 - Milligan-Tennant Injury Protection Index
 - Incremental Cost
 - Maneuvering Index
 - Speed & Economy Index
 - Practicality Index
- Basically, categorize the characteristics and evaluate separately, offer final score.

Good Platform, Some Modifications

- Part 1 – Human Factors
- Part 2 – Boat Characteristics
- Part 3 – Device durability, practicality



Where to Start?

- Access to expertise
- Access to equipment
- Need for progress
- Is there an essential order of events?

Who, What, When, Where,
How, Why

Boat Characteristics (Part 2)

Who

■ Robert MacNeill

- Boat Designer
- President, Carver Yachts
- Industry Consultant
- Propeller Strike Victim
- Outspoken Safety Advocate

■ Richard Akers

- Professional Engineer (Maine and California)
- Small Craft Engineering, LLC
- U of Michigan Naval Architect
- Ship simulation software designer

■ Cliff Goudey

- MIT - MS in Naval Architecture & Marine Eng.
- MIT - MS in Mech. Engineering
- Director, Center for Fisheries Eng. Research



What



- Goal: Develop a Independent Test Protocol
→ *No Preconceived Notions*
- Sample Boat and Guard to Test Protocol Ideas:
 - 17', open sterndrive boat, as identified by risk statistics.
 - Cage-Type guard, completely guards propeller (front, back & sides) and is commercially available for this boat, though not intended for planing hull.
 - Sensors to read 3D accelerations and roll, pitch, yaw rates.
 - Test to real-world conditions not destruction.

How?

- Begin to determine:
 - What does this type of boat do?
 - Time to Plane, Back Up, "S" turns, Circles, Docking, Top Speed, Slalom course, Engine Characteristics.
 - Decide what needs to be measured.
 - Specify/design sensors to measure aspects of each determined maneuver
 - All data should be synchronized (time-stamped) for analysis
 - Caveats
 - Tests have to be repeatable
 - Minimize operator effect on comparative results.

How?, Continued

- How would these characteristics change with a guard installed?
 - If there is a change, is it acceptable?
 - From a safety standpoint (e.g. boat is uncontrollable)
 - From quality of experience standpoint (e.g. boat fails to plane)

Where?

- Use existing USCG Resources
 - Solomon's Island, MD Testing Center
 - Patuxent River



When?

- Begin gathering information before the next BSAC meeting.
 - Have an update for the next IBEX Session
- **DONE IN WARM WEATHER!!!**

Who, How & What Meet with Where

- 1 Boat
- 1 Guard
- 3 Experts
- Solomon's Test site, Sept. 26-28



Why?

- Evaluate a Draft Protocol
- Determine Key Boat Characteristics
 - RPM vs. speed
 - 4 Buoy Slalom Course (2 port, 2 starboard turns)
 - Complete circle turns and figure eights
 - Straight line acceleration and deceleration
 - "S" turns

Why Cont...

- Determine What Data is Needed:
 - Evaluate equipment on-hand
 - Evaluate knowledge of identified experts
 - Consider effects of location, wind, water etc. on test protocol
 - Consider practicality and repeatability of protocol elements
 - Discuss application to other protective devices, boats

Observations From Solomon's

- Available accounts of protection devices causing erratic behavior:
 - None noticed, so do we have a way to predict or test for this behavior?
- How are we going to evaluate acceptable vs. not acceptable?
 - Could informing a consumer suffice on some behavior (e.g. loss of speed or acceleration)?

Observations From Solomons Tests

- Need for More Data
 - Continue/refine types and models of sensors for tests
- Begin to Digest and Compare Industry Suggestions
- Begin to determine what elements are necessary to determine possible un-safe characteristics.

Results From Solomon's

- Our Experts Are on the Right Track!
 - Good brainstorming team
 - Vary from industry connections to academic researcher from MIT
 - Not interested in a 15 year Science Project
 - Are excited to be on this project!

What Now?

- IBEX 2006 Presentation
- December/January meeting to crunch data, start to solidify protocol.
- Find Commercially available product
 - Same Boat – as many different protection devices as available.
 - Test New Product under MIT Umbrella, Summer 2007

What Now?

- Begin Gathering Elements for Phase 1
 - Maintain Robert MacNeill as an expert
 - Identify 2 additional experts in the field of personnel protection/life safety
 - Develop a draft protocol to evaluate the level of human safety provided by a protection device.

Thinking Ahead....

- Provide potential device manufacturers with:
 - A complete test protocol, including human factors, boat characteristics, device durability.
 - A list of independent labs certified by the USCG to perform the testing.
 - Investigate means to make expensive equipment available.
 - Publish results of 3rd party testing on a USCG website to inform boaters of the characteristics of a protection device under consideration.

Hello, I'm Phyllis Kopytko, a Director of SPIN – Stop Propeller Injuries Now!
I am the survivor of the story in this new brochure published recently by the USCG.
We request, you, the manufacturers obtain copies from the USCG and include them
the information and education packages for every product you promote, sell, and
distribute. Once our boaters know how to protect themselves, we will all win.

We are a 13 year old volunteer victims advocate group of survivors of boat propeller strikes, and families of those fatally injured.

We believe every life is worth saving. We are advocates, not engineers. IF the technocrats and regulators had the WILL to provide safe technologies, there is no reason – neither mechanical nor philosophical – neither scientific nor sane – that should prevent bringing technologies to protect people from propeller strikes to market. No one can argue that this is the most gruesome of accidents.

A. Severity and Nature of Injuries. The consequence of fatalities, amputations or severe injury by coming in contact with an exposed propeller is very high. No one can argue that we don't need more deaths or amputations to prove this point.

B. Statistics/RISK. Although this committee has focused attention on technological solutions; ABYC's new committee looks very promising; NASBLA has heightened interest; and USCG proposed regulations are in the works; STILL TODAY there is **no** national campaign, **no** regulation, **no** mandatory education, **no** ANSI approved hazard warning label, and **no** mandatory technology requirement.

This summer of 2006 has been a blood bath of excessive prop strikes across the nation. We collected news stories on 106 propeller strikes. The USCG has collected approx 175 accidents even before receiving any reports from the States. Our summary chart is on the back table. Specifically, our children 18 and under represent 37% of accidents researched. In fact, 60% of **all** injuries and fatalities occur at 30 years of age or under. The conclusion is obvious: our children and young adults are most at risk. **AND IN THE PAST 3 WEEKS, 4 STRIKES, 4 MORE DEATHS MORE OCCURRED IN JUST OCTOBER, AGES 16, 20, 22, & 23.**

C. At Risk:

Fun water sports put our children at risk: tubing, skiing, swimming, snorkeling, wake and knee boarding, PWC riding, etc. Families enjoying such activities must be protected

from the exposed propeller. In other unguarded instances, unattended children are backed over or thrown from the boat. Children are hurt in attempting to re-board when the engine is running or in idle.

D. Match a technology to the accident scenario.

We have taken the 106 accidents we found in the media & tried to apply one of the 5 known safety technologies. We are not privy to the particulars in any of these accidents, but many allow us to make educated assumptions. Some would have been prevented with one or another technology; or a combination. This is particularly true in falls overboard situations. Some accidents are clearly operator error and might be prevented by mandatory boating education – **or not.**

1. **Propeller Guard.** Because some media reports were not clear, 21 accidents are excluded, leaving the guard, in absence of effective education, as the most effective deterrent in **82 accidents.**
2. **Emergency Stop Switch Lanyard** – When an **operator** goes over-board (**22 accidents**)
3. **Falls Over-board Wireless Sensor** – When any **occupant goes overboard (30 accidents)**
*** If the operator and every occupant wears a sensor in lieu of a lanyard, **52 accidents** could have been prevented
4. **Ladder Interlock** – re-boarding (**3 accidents**)
5. **Warning System** – when backing up or approaching a swimming area. (**3 accidents**)

Accident examples for applicable technologies & combinations:

A 36-year-old Florida man was a passenger. Both he and the operator were thrown out of the boat. The boat began circling. He tried to climb back in - the prop struck his leg. What technology might have prevented this? A guard, A Lanyard; Wireless sensors.

A 57-year-old Montana woman a passenger who fell off the bow of boat and was struck by the propeller and killed when the driver circled around to assist her.

What technology might have prevented this? A wireless sensor; A guard.

Minnesota two people towed in inner tubes fell off and the driver turned to get them, hitting both of them with the propeller. What technology might have prevented this? A Guard.

A two-year-old Florida stern-riding toddler fell into the propeller of his father's 18 foot boat while backing into the dock. A guard would have made all the difference in what must have been a parent's panic. A **back up warning** would only have helped if another responsible adult was on board. Small children are not equipped to save themselves.

An Idaho woman was preparing to go tubing when her husband accidentally put the boat into reverse, lacerating his wife's leg and ankle. Accidents happen! The only thing that would have prevented this was a Guard.

A California sheriff, boards a PWC in a federal waterway in a neighboring state. He dies when he collides with the propeller of a passing boat. PWC riders tangling with boat propellers is a common occurrence and represents at least 7 of 106 accidents this summer. PWC off throttle steering (retrofitting all pre-2006 models), education, and a (guard).

A woman, me, a man, my late husband, and another man, a very educated, certified fishing guide, in 1994, all caught in the circle of death. What technology would have prevented this? A lanyard, wireless sensors.

A pontoon boat at Lake Oroville, CA was rented, with no instruction, to inexperienced young adults. In a sharp turn, a young woman fell off the bow, through the pontoons and into the propeller. Three weeks in a coma, with serious head and brain injuries, the loss of one eye, and months later, still in the hospital, one is left to wonder how rental companies can continue to get away with not protecting their clientele. A guard is a given on all pontoon boats. Install them. What are we waiting for?

E. Mitigating factors: Technology and Education

The **first line of defense is to install these propeller safety technologies** and to use alternate jet or jet-pump technologies, and even PWC off-throttle steering – all available after-market. As manufacturers, engineers and dealers, it is your

responsibility to promote the installation and use of these technologies.

The second line of defense is education. Refer to our website at www.spin-site.org. You can warn your children about the hidden hazard below the water. You can emphasize this for all water sports. Assign an adult to each child. Keys in your pocket when not underway eliminates accidental starting of the engine. Warn that even an idle engine has a spinning propeller and the prop doesn't stop immediately. Teach & practice the count to ten rule before boarding or disembarking, **give the prop a chance to stop**. Warn and prevent. You cannot repeat this often enough. Unfortunately, in the end it is not WHAT you know or HOW many times you have been warned WHEN you get within striking distance of the blades of a spinning exposed propeller – THE PROPELLER ALWAYS WINS. **Install the Technology**, which can only be promoted by you, the manufacturers, dealers, and marine industry. **HELP our Boaters WIN!**

Edited October 23, 2006