Naval Safety Center

LESSONS LEARNED

LL 21-26

ASSAULT AMPHIBIOUS VEHICLE SINKINGS

As the Marine Corps begins to usher in the new Amphibious Combat Vehicle (ACV), the replacement to the long-used Assault Amphibious Vehicle (AAV), it's a good time to take a look at some of the more significant mishaps from the AAV's time in service and glean lessons that may be applied to its final days in the Fleet and to its successor.

The Marine Corps' mission is amphibious in nature, and the methods of getting ashore are vital, but they are also some of the most dangerous activities we conduct. Setting aside the considerable threat that enemy fire could pose during a ship-to-shore movement, amphibious transports are subject to complex environmental hazards that are exacerbated when human error is thrown in the mix. Here are some incidents to help us learn and mitigate those hazards.

- Speed matters. An AAV took another vehicle under tow from shore. About 400 meters after splashing, the vehicle commander of the towed AAV sent a radio transmission to slow down because the speed was causing his AAV to submerge, but the message wasn't received in the other vehicle. After multiple radio attempts, the vehicle commander attempted to communicate with the battle lantern, but the other crew didn't notice it either. Meanwhile, the towed AAV was submerging and filling with water. Once the water in the troop compartment reached waist level, the vehicle commander made the wise decision to evacuate the crew. Due to water pressure on the troop compartment hatches, the crew members could not evacuate from that route and had to egress from the turret. — *This mishap shows why the manual says "the towing crew must keep a view aft to monitor the towed vehicle." An alarming note in this report was the members had not practiced egress training before the incident, so they were fortunate to have been able to find their way out. It's common practice for one vehicle to tow another in the water when one has a mechanical failure or meets some other dead-lining criteria. We must adhere to specific techniques, though, specifically slower speeds.*

- Slow it down, please. During training, a Mine Clearing Line Charge (MCLC) equipped AAV lost power while in the water, including the power to the radio, so another AAV came to tow it ashore. Once moving, the vehicle commander of the towed vehicle observed water coming through the driver's hatch plug and the MCLC periscope area, because the periscope wasn't attached. He also noticed the AAV beginning to travel downward in the water (due to its speed being towed), potentially submerging it. With the radios down, the vehicle commander decided to open the troop commander hatch to attempt to visually signal the lead AAV to slow down. He managed to relay the message and assumed his position again, but while the hatch was open, water rushed in, flooding the troop compartment to knee level. This flooding caused the AAV to sit even lower in the water while being towed, eventually leading to the AAV striking and dragging on a reef. While the crew worked to disengage the AAV tracks so they could roll freely and be removed from the reef, a wave crashed on the back of the vehicle, pushing water to the front of the crew compartment and forcing the AAV into a depression in the reef. Due to the amount of water in the AAV at that time, the vehicle commander decided they must evacuate the vehicle. — *As with the previous example, slower towing speeds are essential.*

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- Did you close the door? A surprisingly brief report, especially given the nature of the mishap, describes an AAV that was rigged for tow but sank during the movement. An AAV reached the beach and was deemed inoperative. Another AAV towed the inoperative (and unmanned) vehicle from the beach to take it back for maintenance. Shortly after the towed vehicle entered the water, it sank. The report simply states that it appeared a Marine opened the back hatch to secure the tow bar and left the hatch open. — *It's incredible how fast the water flows in an open door.*

- Use your equipment correctly, and use the proper equipment. A student driver was operating the vehicle during AAV operator training, with an instructor in both the vehicle commander hatch and the troop commander hatch. Two other students and a crew member were in the rear troop compartment. The student driver drove the vehicle into the water with the bow plane retracted (as he should), but did not extend it when he should have. The purpose of the bow plane is to displace water from the bow of the vehicle to reduce the effects of waves over the front of the vehicle which could intrude into open hatches or intakes. After proceeding for about 100 meters, the instructor in the troop commander hatch (just behind the driver), observed the vehicle's engine RPM was too high and advised the student to slow down, but the accelerator was stuck in the depressed position. The vehicle began to submerge, so the instructor ordered the three personnel in the troop compartment and the instructor in the vehicle commander hatch to evacuate while he and the driver attempted to free the accelerator. Their efforts were unsuccessful, so he and the driver evacuated along with the other instructor and the two students in the vehicle's rear. The crew member that was in the rear failed to make it out, however. Due to not wearing a helmet, he received a head injury that impaired his ability to escape. — *Using the equipment properly (bow plane) and using the proper equipment (the right PPE) saves lives. Of additional note, the student driver was a poor swimmer with an intense fear of water that impeded his ability to operate the vehicle effectively. Make sure your people meet the requisite safety standards and know their individual strengths and weaknesses; it will mitigate risks and ensure they can do their assigned job.*

- An AAV platoon was conducting movement from shore to ship. The day before, the platoon commander developed a detailed plan with Navy personnel for the ship to recover the AAVs at the minimum distance to shore. However, on movement day, operational factors required the ship to relocate, extending the distance the AAVs would need to travel. This distance alone would not have been an issue, but weather conditions were causing a rapidly deteriorating sea state, and ineffective communication between ship and Marine personnel ashore resulted in the AAV leaders not being aware of how quickly conditions were worsening. The AAV platoon's swim time was significantly extended and was conducted in weather conditions that put additional strain on the mechanical components of the vehicles. One AAV was already having mechanical issues before launching. AAVs have two electric and two hydraulic bilge pumps, but one of the electric pumps in this AAV was not working. AAVs can operate with one inoperative pump, but the reduced ability to expel water — compounded with the worsening sea state and extended time in these conditions — led the AAV to slowly flood, causing further damage to mission-essential equipment. This flooding eventually led to a hydraulic failure and a complete inability to expel water effectively. The Marines were forced to evacuate, and the vehicle sank. — *This incident resulted in the total loss of an AAV and had the potential to be much worse. Had the forecasted weather been communicated and accounted for, AAV movement could have been postponed for better conditions or better ship positioning.*

Key Takeaways / Lessons Learned

The sea is an unforgiving environment, and it is more unforgiving if we become complacent to the hazards we create ourselves. Keep these lessons in mind to mitigate some of these hazards.

1. **Take special consideration when towing**. The majority of AAV sinkings have occurred when towing. During these events, the broken down vehicle is at the mercy of the towing vehicle. Slow things down a bit to make sure everyone stays afloat. Stern to stern towing is what the technical manual directs, and it seems to reduce the natural submarining tendency that occurs at higher speed.

2. **Deploy the bow plane when necessary**. Because the AAV is designed to sit low in the water to create a smaller profile, water can rush over the top of the vehicle, creating downward force and a potential for a submarining effect at higher speeds. The bow plane is designed to counteract this force. Make sure it is deployed when necessary.

3. **Conduct thorough pre-water operation checks and splash team checks**. Water will make its way into the vehicle, especially when operating with the top hatches opened. Reduce extra strain on the systems and prevent unnecessary water intake by ensuring everything that can be water-tight is.

4. **Maintain situational awareness via adequate communication**. AAV operations are especially hazardous. All stakeholders need to be aware of changing conditions. Ship's crew must keep AAV personnel apprised of changes that will affect their movement, and conversely, AAVs must keep the ship informed of the status of the vehicles and any support that may be needed. This communication shortens response times and improves decision-making ability. Good vehicle-to-vehicle communication during towing is a life and death requirement (refer to #1).

5. **Be prepared for the worst**. There are standards for egress based on the water level within a vehicle. Ensure crew and troops being transported understand these standards and act upon them without hesitation. Everyone has a better chance of swimming on the surface than in a sunken AAV. Ensure egress methods are understood and rehearsed; you don't want your Marines and Sailors trying to figure out the escape route in the middle of an emergency. Finally, always have a safety boat or recovery vehicle standing by. Whether or not to evacuate a vehicle in distress should not be contingent on the availability of rescue.