The Simple Truths of Safety at Sea for the Alaska Tender Fleet: A Study of Tenders in the 17th Coast Guard District

Prepared For:

Alaska Independent Tenderman's Association (AITA)

Report Date:

July 31, 2014

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INTRODUCTION

This report seeks to understand the scope, nature and causes of tender vessel incidents, in the 17th Coast Guard district. By working with tender operators, crews, the United States Coast Guard, and other experts in the field of vessel safety, this report analyzes recent data related to tender incidents and proposes reasonable and effective regulation to mitigate future incidents involving these vessels. This is the first report to do a risk based analysis of the data related specifically to tender vessel casualties and it has been undertaken to assist regulators and other stakeholders in having an accurate, reality based understanding of the tender fleet, it's challenges and it's truly unique nature amongst the fishing fleets of the 17th district. It is important to take into account the unique realities of the tender vessel fleet and be sure that any future regulations they face are rational, reasoned and focused on reducing the actual causes of tender vessel incidents. To do otherwise, and apply regulation to this fleet that has been applied to vastly different fishing fleets, presents a very real danger of unnecessarily regulating tenders in the 17th Coast Guard district out of business while simultaneously failing to address the real dangers these people face. In short, regulation should not be applied in a reality vacuum. This report seeks to break the reality vacuum by examining the available data on tender vessel casualties.

Tenders constitute a specific fleet of vessels that do not directly catch fish but instead act as a buying agent for seafood companies, purchasing, refrigerating, and transporting fish from the fishing vessels to the shore processing plants or floating processing vessels (hereafter referred to as "processors"). Tenders therefore have important differences from other fishing fleets, and the regulations they must comply with should be tailored to those differences.

Unlike those that dominate the fishing vessel fleets, tendermen are not in it for the money. Popular television portrays the "cowboy" lifestyle of some of the other segments of the commercial fishing industry, emphasizing the qualities that those fishermen possess that have made them successful. They are aggressive and ultra competitive or they wouldn't still be fishing in a post fishing industry rationalization world. The rationalization process rewarded the most aggressive in the fleet. These qualities have contributed to a "throw caution to the wind" attitude that made some segments of the fishing industry truly dangerous. Those fleets also have profit margins that can accommodate costly regulation. All of this is in stark contrast to the world of tendering.

Comradery is the hallmark of the 17^{th} district tender fleet. Families are raised aboard tender vessels and it's common for a family operation to be in its third and fourth generation. Tendering is about service. It is gratifying for tendermen to be able to help fisherman do their jobs by providing necessities and niceties that make the fishing life more bearable. During peak season tenders are working 24 hours a day buying fish, refrigerating it, providing showers, fuel, laundry service, food, parts and mechanical expertise for fisherman, then taking the product to market for processing. When there is a break in the action, they raft up with friends to have dinner, go beach combing and have bonfires. Tendering is truly and obviously a way of life, not just a job, and its preservation should be a goal.

1 THE INDUSTRY

The fishing industry is the largest private employer in the state of Alaska. Overall, this means that one in seven Alaskans is employed because of Alaskan seafood, and in 2011, the industry directly created 63,100 jobs in the state. When viewed more broadly, the Alaska Seafood Marketing Institute's report estimated that the industry provides 165,800 American jobs, including 34,000 jobs for Washington state residents as well as thousands of jobs for hatchery managers, restaurateurs, grocers, and distributors throughout the nation (McDowell Group, 2013).

While the Alaskan commercial fishing industry is both lucrative and sustainable, it also presents unique and momentous challenges. The United States Coast Guard recently published a comprehensive review of lost American fishing vessels and crew fatalities throughout the entire nation.[1] Between 1992 and 2010, a total of 2,072 vessels were lost, and 1,055 fatalities occurred in United States waters. Alaskan waters had the highest death rate, with 239 individual deaths, or 22 percent of the total. They also accounted for the largest proportion of vessels lost, with a total of 479 vessel casualties, or 26 percent of the total vessels lost. Comparatively, the Eighth Coast Guard district, which includes Texas and a large part of the Gulf of Mexico, accounted for the second highest number of vessel casualties, at 365 vessels, as well as the second highest number of worker deaths, at 200 individuals (Dickey, 2011).

As one of the most hazardous professions in the United States, Alaska commercial fisheries collectively have a death rate that is 26 times higher than the average for all U.S. workers (Lincoln & Lucas, 2010). Between 1991 and 1996, there were a total of 146 deaths in the Alaska fishing industry, equivalent to 140/100,000 full-time employees. In contrast, for all workers in the United States, the annual fatality rate during this time was 4.4/100,000 workers (Thomas, Lincoln, Husberg, & Conway, 2001). Since the early 1990s, specific efforts have helped reduce fatalities by 42 percent, yet between 2000 and 2010 there was still an average of 46 deaths per year, or 124 deaths per 100,000 workers (Dickey).

Loss of life is clearly a serious and prevalent threat aboard commercial fishing boats in the United States. Capsizing, fires, and explosions can and have occurred on fishing boats, and all have potentially deadly consequences. As previously stated, the U.S. Coast Guard determined that 479 fishing

[1] This report did not make distinctions between fishing and tender vessels. Therefore, we cannot reach conclusions regarding the death rates of workers on tenders from this report.

vessels were lost between 1992 and 2007 in Alaska, including 58 vessels in the last 5 years of the study (Dickey, 2011). In this study, the most common cause of vessel loss was flooding, accounting for 36 percent of total losses. Fires and grounding were the second and third most likely causes of vessel loss, accounting for 20 and 16 percent of causes, respectively (Dickey, 2011). However, as we explore more thoroughly later in this report, the causes of *tender vessel* losses do not follow the same pattern.

Already, the fatalities in Alaskan waters have declined significantly, likely due in part to a task force implemented in 1999 aimed at reducing vessel loss. The U.S. Coast Guard's 2011 analysis concluded that simple measures, such as training workers for emergencies and using proper personal flotation devices and life rafts, could save many lives, as water exposure caused more than three-quarters of all fatalities. Additionally in this study, the Coast Guard found that only 10 percent of the individuals who died because of vessel loss were using a personal flotation device (PFD) or survival suit when they entered the water, but fishermen survive more than twice as often when survival equipment is properly used (Dickey, 2011). It is important to note that the reduction in fatalities was due to simple, relatively inexpensive measures, such as training and PFD's rather than costly vessel changes or following expensive load line requirements.

While previous data, including the analysis completed by the United States Coast Guard, clearly outlines and documents many types of maritime casualties throughout the nation, this report will be the first one to investigate casualties that occur solely on tender vessels in Alaska. Some regulation has already been implemented to protect those onboard commercial fishing vessels of all types, but this report seeks to examine additional and/or alternative regulation and to offer new solutions to risks specific to the tendering profession.

The process of harvesting seafood is as varied as the fish consumers choose to buy. In many fisheries, fish are taken from the sea by vessels such as gillnetters, trawlers, seiners, crabbers, and trollers, and are then taken to processors on a separate vessel called a tender. While catching fish is the initial step in the Alaskan fishing industry, the fish must also be prepared for market at the processor. These vessels and plants take the raw fish and generally remove the head and eviscerate, trim, and wash each fish. The degree to which the product is prepared varies between processors; some fish are processed and frozen, some are canned, some are filleted and fully prepared for cooking or reprocessing, while others are packed with gel ice and shipped to restaurants to be served soon after they are caught.

Vessels that do not either process their fish directly or take their catch to a processing plant largely rely on tenders to transport fish for them. This allows the fishing vessel to stay on the fishing grounds for a longer period of time, thus maximizing their catch and profits. It also enhances processing efficiency at the processing plant or vessel because tenders can deliver large volumes of fish in a short amount of time, which allows processors to produce more product per hour without wasting time coordinating smaller deliveries. When compared to that of a tender, the turnover time for the smaller capacity fishing vessels to pull up to the processor, dock, unload, and leave is quite time consuming and inefficient.

When a fishing vessel arrives at a tender, the tender uses a large vacuum pump or a brailer bag hoisted by booms or cranes to transport fish from the fishing boat or net into the tender. The catch is weighed by scale, and the fisherman is given a “fish ticket” which describes the weight and type of fish, the catch area, and the species of fish (for example, sockeye versus coho salmon). This fish ticket essentially acts as cash, and the fishing vessel may receive the money promised on the ticket at their earliest convenience.

On the tender, fish are either placed in slush ice or in refrigerated sea water tanks, which can hold upwards of 500,000 pounds of fish. These boats also assist the fishing vessels by bringing supplies to those on the fishing grounds, including drinking water and food, and other luxuries such as cold drinks, access to hot showers, and ice cream. A tender may unload more than a dozen boats before returning to the processor (Johnson & Byers, 2003). Unmistakably, the tender vessel, is an integral part of the Alaskan fishing industry.

Yet regulating tender vessels presents distinct challenges because of their unique place in the industry. Operating a tender is not as profitable as fishing or processing, and as a result owners often do not have large sums of money to invest in their vessel. Unlike other fishing vessels, which are paid for their catch, processors pay the tenders a daily rate for their efforts. In this respect, tenders are seen as a business expense to the processor, which means that their pay is minimal when compared to a processor or fishing vessel. Of the price that consumers pay at retail, about 3 percent of that price goes to tenders, while fishermen receive 10 percent, and processors earn 16 percent (Johnson & Byers, 2003). Even though tenders are guaranteed a somewhat consistent pay rate, they do not experience the windfall profit that comes with a larger catch. Because of this fixed income situation, tender vessels are more likely to age and become worn without surplus funds that can be invested in maintenance and safety (Duz, 2013). Therefore any reasonable regulation must take into account a tender vessel's limited budget.

Additionally, some other types of vessels, such as crabbers and trawlers, are used as tenders during the salmon and herring seasons in order to generate income when they are not fishing (Johnson & Byers, 2003). Unless regulators clarify which set of regulations this subset of tenders must follow while tendering, then it means these vessels may have to comply with two or more sets of regulations while also remaining profitable. It is vital that all stakeholders and regulators understand the unique set of economic and operational challenges that tenders face in order to meet those challenges with relevant and targeted regulations.

2 BACKGROUND INFORMATION ON REGULATION

2.1 Law and Enforcement

The United States Coast Guard (USCG) is "authorized to enforce, or assist in the enforcement of, all U.S. Federal laws applicable on, over, and under the high seas and waters subject to the jurisdiction of the United States" (14 U.S.C. § 2).

In general, the laws and acts passed by United States Congress are codified in the United States Codes (USCs). Executive agencies, such as the United States Coast Guard or Occupational Safety and Health Administration (OSHA), then carry out these laws through the development and enforcement of regulations. Regulations are designed to increase efficiency and flexibility of Congressional laws, and they are generally created through a process that invites public participation in the construction of regulations.. Unfortunately, citizens often overlook the opportunity to participate in this creation process, yet it is an important step in forming effective and reasonable regulations. Agencies such as the USCG are assigned to promulgate regulation because of their expertise and depth in a given subject matter. The USCG publishes and has authority to enforce regulations in portions of Titles 33 and 46 of the Code of Federal Regulations.

Title 33, *Navigation and Navigable Waters*, delegates regulations in Chapter 1 to the USCG while Chapters 2 and 4 are delegated to the U.S. Army Corp of Engineers and the Saint Lawrence Seaway Development Corporation, respectively. In Code of Federal Regulation (CFR) 33, the USCG ensures compliance with rules pertaining to vessel security, general boating procedures, transfers of hazardous materials, and navigation safety regulation, among many other topics. Title 46, entitled *Shipping*, is divided into 4 chapters, of which the U.S. Coast Guard is to enforce Chapters 1 and 3 (the U.S. Maritime Commission regulates Chapters 2 and 4). These chapters contain rules regarding proper vessel certification, general operation techniques, hazardous chemical management, safety procedures, and more. Chapter 1, Part 28 of this CFR concerns requirements for the commercial fishing industry in the United States, and thus serves as the basis for current regulations in the commercial fishing vessel industry.

Two major pieces of legislation, the *Commercial Fishing Industry Vessel Safety Act of 1988* and the *Coast Guard Authorization Act of 2010* resulted in significant amendments to Titles 33 and 46, and the *United States Coast Guard and Maritime Transportation Act of 2012* made additional changes. These Acts are the most important pieces of legislation affecting safety for the commercial fishing industry in the United States today.

2.2 The Commercial Fishing Industry Vessel Safety Act of 1988 (CFIVSA)

The Commercial Fishing Industry Vessel Safety Act of 1988 (P.L. 100-424) initiated regulation of the commercial fishing industry. This Act took effect in 1992 and sought to address the unnecessarily high number of fatalities at sea. These new regulations required vessels to carry life saving equipment, survival crafts, distress signals, emergency positioning indicating radio beacons (EPIRBs), fire extinguishers, emergency alarms, bilge pumps, and more. This Act also contained regulations for watertight integrity.

The Act was very successful, as worker fatalities declined significantly after its implementation (Garofolo, 1997). Two important aspects of this Act helped foster its success. First, it established an advisory committee, named the Commercial Fishing Industry Vessel Safety Advisory Committee (now known as the Commercial Fishing Safety Advisory Committee), made up of fishermen, marine-safety representatives, safety equipment vendors, and other experts to help set safety regulations and recommend measures to the Coast Guard. Fishermen and policy-makers alike favored this advisory board, as it helped guide effective, yet efficient, regulatory standards. Second, the voluntary dockside examination program was a key component in fostering this Act's success (Garofolo). This program allowed fishermen to request a free, no-fault examination by the Coast Guard to ensure their vessel's compliance with the law. These safety checks were extremely helpful in allowing fishermen to get recommendations for improvements without fear of punishment.

This Act also broadened the USCG's authority. It gave the Coast Guard permission to complete safety checks at sea and to prevent vessels not in compliance from operating, helping to further enforce safety measures mandated by the Act. The combination of no-fault, no-cost safety checks and inclusion of the ability to board and terminate a voyage in the arsenal of enforcement actions helped enhance vessel safety and decrease loss of life in commercial fishing operations (Garofolo).

A study completed by the National Institute for Occupational Safety and Health (NIOSH) found that between 1991 and 1999 the *survival* rates of workers in vessel capsizing and sinking events steadily increased from a 77 percent survival rate between 1991 and 1993 to a 94 percent survival rate between 1997 and 1999 (Lincoln & Lucas, 2010). This data suggests that CFIVSA helped reduce worker fatalities when vessels sink or capsize. However, while this Act improved safety, vessel casualties remained unacceptably high.

2.3 The 2010 and 2012 Coast Guard Authorization Acts

The Coast Guard Authorization Act of 2010 (P.L. 111-281), signed by President Obama on October 15, 2010, sought to address the persistent hazards in the commercial fishing industry and improve upon the legislation in CFIVSA (United States Coast Guard, 2013). This act amended USC 46, required new safety protocols and equipment, made significant changes to the sections regarding load lines and uninspected fishing vessels, and defining requirements for Alternative Safety Compliance Programs.

This Act required many new safety protocols. Instead of simply requiring a "lifeboat or liferaft" as previously outlined in CFIVSA, all vessels that operate beyond 3 nautical miles are now required to carry "a survival craft that ensures that no part of an individual is immersed in water" (46 U.S.C. § 4502(b)(2)(B)). Also, to improve overall vessel safety, individuals in charge of vessels that operate beyond 3 nautical miles must complete a training program every 5 years that includes topics such as fire fighting, emergency drills, navigation, seamanship, stability, and more.

Other regulations in this Act apply directly to vessel construction and maintenance. Vessels operating beyond 3 nautical miles are required by the 2010 Act to complete a dockside safety check every 2 years and carry certification documents on board, whereas the CFIVSA did not mandate such safety checks (the voluntary exams are still encouraged for vessels that operate closer to shore). The Act also amended the section in Title 46 regarding load lines (the line on a ship indicating the depth to which it sinks in the water when properly loaded.), making the load line requirement mandatory for all vessels 79 feet long or greater and built after July 1, 2012 (*Determining a Vessels Load Line Length*, 2013). Additionally, alternative load line requirements for vessels that do not meet these specifications must also be formed through cooperation between the fishing industry and regulators.

The classification system for vessels has also increased in scope to include not only processors but also fishing and tender vessels. This classification system is essentially a series of safety checks and regulations outlined by the American Bureau of Shipping, or other recognized classification societies, and completed by the Coast Guard to ensure seaworthiness. Vessels that are at least 50 feet in length, were built after July 1, 2013, and operate beyond 3 nautical miles from shore are now required to comply. Fishing vessels, fish processors, and fish tenders that do not meet the requirements for the classification system are required to comply with an Alternative Safety Compliance Program (ASCP) to be developed between the fishing industry and regulatory agencies by January 1, 2017 and implemented by July 1, 2020. The tender vessels that must comply with this program must participate in Aleutian trade and fall into one of the following categories:

1) A vessel that is at least 50 feet in length, built before July 1, 2013, and is 25 years of age or older (in or after 2020), *or*
   A vessel that is built before July 1, 2013 that undergoes a "substantial change to the dimension of or type of vessel completed after the later of July 1, 2013, or the date established by the Secretary" (46 U.S.C.§4503(d)).

If an owner operates 30 or more vessels that are mentioned in (1), they may enter a compliance agreement effective January 1, 2030.

This forthcoming alternative compliance safety program is important for understanding this report, and the details and reasons for this legislation are discussed below. There is currently one similar agreement in place, and the tender fleet will eventually be regulated by another compliance agreement as mandated by this Act.

President Obama signed the United States Coast Guard and Maritime Transportation Act of 2012 (P.L. 112-213) on December 20, 2012. The changes this Act made to Title 46 were not as significant as CFIVSA or the Authorization Act of 2010, but are important for understanding current regulation nonetheless. The 2012 Act changed dockside examination policy for relevant vessels by requiring checks every 5 years instead of every 2. The examinations are also required for vessels built after July 1, 2013, rather than July 1, 2012 as previously mentioned. Other changes in this Act leave the Alaska fishing industry largely unaffected.

Federal regulation of the commercial fishing industry is, undoubtedly, more stringent for newer and larger vessels. Therefore, to avoid more burdensome regulation, many fishermen delay purchasing new boats and instead choose to operate older, potentially less-safe vessels, which may ironically lead to more vessel and worker casualties. Or fisherman may decrease the amount of fishing or processing they do in order to operate under less regulation. Yet while this may seem cost-effective, these vessels may be more prone to casualties and fatalities. In Dickey's (2011) study on vessel casualties between 1991 and 2010, vessels were more likely to capsize and lead to casualties the older they were, and to combat these issues a number of Alternative Safety Compliance Programs (ASCPs) are in development as required by the Authorization Act of 2010. It is unfortunate that regulation that is intended to improve safety outcomes, if accompanied by a high cost, sometimes forces people to make economically expedient choices which thwart the intended purpose of the regulation, in this case improved safety. This is part of the reason that it is so critical for the economic realities of the targeted fleet to be taken into consideration. This is especially true when it is clear that many of the most successful solutions to safety problems are, low cost, practical and highly efficacious. For any alternative safety compliance program to be effective, it must be made to fit the fleet it is intended for.

There is one alternative safety compliance program currently in place called an Alternative Compliance and Safety Agreement (ACSA), and it applies to three different catcher/processor (C/P) sectors: the non-pollock freezer trawler, the cod freezer longline, and the pot cod sector. These vessels both catch and process fish, but there are restrictions on the amount of processing a vessel may carry out under this program. For example, a vessel in this program may remove the head, guts, and tail of the fish and also process stomachs, cheeks, and roe. However, they are not allowed to fillet or process the bones or belly flaps. These types of processing actions would classify the vessel as fully classed and loadlined, which would create more costly regulation for the owner. This program was first established by the United States Coast Guard in 2006 and last revised in December of 2012.

To create agreeable regulatory standards for all parties involved, the Coast Guard worked closely with C/P stakeholders and arrived at the current, evolving ACSA. While the full agreement and guidelines are quite lengthy, the main priorities of this Alternative Compliance and Safety Agreement (ACSA) are divided into 11 subsections highlighted below:

- *Vessel Stability*: To ensure that the vessel is stable at sea, the boat must have watertight bulkheads and closures, and the sea valves, automatic closure devices, and sump pumps must be examined for integrity. [Load line certificate and stability letter.]

- *Drydock and Internal Structural Exams*: The propeller, stern bushing, sea connections, weldments, shell plating, sea chest, sea strainers, emergency bilge suction, internal spaces, anchors, chains, and wires are inspected.
- *Hull Thickness and Gauging*: Hull thickness must be measured on sections in the midship, saltwater peak tanks, main deck plating, sea chests, and others.
- *Tail Shaft and Rudder Exams*: The tail shaft and rudders are analyzed to ensure that they are within the manufacturers specifications and that corrosion and wear are at a minimum.
- *Watertight and Weathertight Integrity*: High water alarms must be installed and audible, door coamings are installed when necessary, and the vessel must have watertight doors, hatches, and bulkheads.
- *Machinery Systems*: Fuel systems must be made of specific materials, and gauges on the tanks must be welded to standards. The fire safety hazards must be identified, relief valves tested, and certain parts on the vessel must be fire resistant, among other things.
- *Life Saving Equipment and Arrangements*: Life rafts must be approved under 46 CFR and one person must be able to launch them. Ladders must be installed for embarkation, and immersion suits must be maintained to manufacturer's specifications and fitted with a strobe.
- *Fixed Fire Fighting Equipment and Arrangements*: There must be fixed firefighting systems in certain places on the vessel, and fire extinguishers must be stored in specific areas, depending on the circumstances.
- *Other Fire Fighting and Safety Equipment*: The vessel must carry portable dewatering pumps and proper firefighting attire. Certain crewmembers must be trained in fire fighting. A safety plan must be used in case of emergencies, and Freon and halon detection systems must be used.
- *Emergency Drills and Training*: Drills must be conducted by a trained individual for disasters such as fire, flooding, abandon ship, and person overboard. Records of these drills must be kept.
- *Emergency Communication and Navigation*: Automated Identification System (AIS) and Global Maritime Distress Signal System (GMDSS) must be installed and operable.

These safety checks must be performed periodically (usually every two years) in order to maintain status under the ACSA (United States Coast Guard, 2012).

The Alternative Safety Compliance Programs mandated under 46 USC 4503 by the Authorization Act of 2010 have not yet been implemented. However, the Coast Guard, in partnership with stakeholders and experts, is currently working toward the creation of mutually agreeable programs for different commercial fleets.

2.4 Other Agents of Change

While the USCG plays an instrumental role in ensuring vessel and worker safety through regulation and enforcement of federal laws, there are also other means of improving vessel safety. The USCG can require vessels in certain geographical areas to follow alternative regulation (in addition to the ASCPs discussed above), and other organizations, such as the National Institute for Occupational Safety and Health (NIOSH) or industry associations such as the Alaska Scallop Association, can suggest safety measures or create protocols within specific industries.

The halibut derby system is a prime example of how simply altering how and when people fish can save many lives. Before 1995, halibut fishing in Alaska was operated on a “derby” system, wherein fishermen were allocated 24-hour periods in which to catch as many fish as possible. The dates of the derbies were established months before the day of fishing and were not flexible to adjust for harsh weather conditions. Between the years of 1991 and 1994, there were 6 fatal events on commercial halibut vessels (Thomas & Conway, 1999).

However, in 1995, the North Pacific Fisheries Management Council implemented individual fishing quotas (IFQs) for halibut and sablefish, which allocated individual catch limits to each vessel. The fishermen were then allowed 8 months in which to fill their quota. This allowed fishermen greater flexibility in determining when to fish, giving operators the ability to adjust their schedule based on weather conditions (Thomas & Conway). Since this rationalization program was implemented, there have not been any deaths on commercial halibut vessels.

Similar changes in the crabbing industry have also helped alleviate workplace hazards. Overloading crabbing vessels with pots has, historically, created many dangers for the crabbing fleet and has caused vessels to capsize unnecessarily. However, some safety measures have helped mitigate these risks. In 1999, the USCG initiated the At the Dock Stability and Safety Compliance Check (SSCC) in the Bering Sea Aleutian Islands (BSAI), which required preseason dock examinations to ensure that fishermen will not overload their vessel. Also, in 2005, many of the BSAI crabbing fleets implemented Individual Fishing Quotas (IFQs) in a new crab rationalization program to alleviate issues that arise in a derby fishing system (Fina, 2004). This system is similar to that of the halibut program, and has also contributed to safety aboard crabbing vessels in Alaskan waters. These two changes, the USCG preseason dockside checks, and the crab rationalization program, have helped decrease the average annual fatality rate of employees in this industry by 60 percent. Between 1990 and 1999 there were an average of 8 deaths per year, and between 2000 and 2010 there was an average of less than 1 death per year. Further, of the 8 individuals who died between 2000 and 2010, 3 fell overboard, and 5 were lost from a capsizing event. The only vessel to capsize during this period did not complete the SSCC (Woodley, Lincoln, & Medlicott, 2009).

Other organizations such as the National Institute for Occupational Safety and Health (NIOSH) have developed technology and recommended policy to ensure that workers are protected at sea. Recently, NIOSH developed an emergency stop device that can be retrofitted to any winch, which helps deactivate a winch in case of personnel entanglement. NIOSH has also introduced a hatch and door monitoring system that prevents flooding on vessels. This system has been tested in the Bering Sea and is in the process of being licensed for the market (Lincoln & Lucas, 2013).

Lastly, associations within the fishing industry can, and have, helped reduce worker casualties. As previously mentioned, falls overboard without flotation devices (especially in Alaskan waters) are one of the leading causes of fatalities. To address this problem, the Alaska Scallop Association and individual vessels in the crabbing industry recently established a 100 percent personal flotation device (PFD) policy for all crew on deck. By educating crews and requiring all crewmembers to wear PFDs, leaders in the development and implementation of this policy hope to reduce casualties due to individuals falling overboard.

The previous examples make clear that there are multiple ways to reduce vessel and worker casualties at sea. It is also important to note that the most effective regulations involve a collaboration of entities that combine expertise. Therefore, pursuing the development of regulation that is not only supported by data, but also the result of a collaboration between regulators, industry and association stakeholders will likely be the most effective way to create effective change in the tender industry.

3 THE DATA

This report analyzes data of tender vessel casualties between the years 2000 and 2012 in the 17th Coast Guard District. When an accident or casualty occurs aboard a vessel in the commercial fishing industry, the owner is required by law to file a report with the USCG documenting the incident. The Coast Guard then records and stores the report, and often other federal organizations, such as NIOSH, may access the data and complete analyses. Due to privacy laws, the original data was not available for purposes of this study, but the NIOSH Alaska Pacific Office generously processed the data and removed its distinctive features so that it could be used in this report. The data of personnel fatalities encompasses the full 12-year time span from 2000 to 2012, while the vessel casualty data analyzes only events between 2000 and 2009. In the fall of 2013, the data for non-fatal tender events between 2009 and 2012 had not yet been processed by NIOSH, and it was therefore unavailable for this study.

The Alaska Independent Tendermens Association (AITA) also provided valuable information for this report. Thirty-two current tendermen from across Alaska filled out a questionnaire regarding their operations, expenses, vessels, and more. Leaders at AITA then compiled these reports, removed identifying features (so that the data may remain anonymous), and then granted access to the data to enhance the scope and breadth of this report. This made it easier to propose reality based, economically reasonable regulations.

Conversations with other experts in the fields of occupational safety and health, Coast Guard regulations, and fishing operations helped enhance understanding throughout this report. Amy Duz, President of iWorkWise, helped propose potential regulations for the *Discussion* chapter, and she also provided general guidance for the direction of this report. Visits to multiple tender vessels at port in Bellingham, Washington and discussions of potential regulation and safety issues proved to be useful in broadening the scope of this report as well.

3.1 Fatal Events

Between 2000 and 2012, the NIOSH Alaska Pacific Office (APO) reported that there were 3 fatal events on tender vessels. These deaths occurred on separate vessels and were a result of three different causes. Overall, the vessels had an average year-built of 1971, an average crew size of 3, and an average length of 81 feet. All vessels were made of steel, two vessels were tendering salmon, and one was not tendering fish at the time of the fatality (Table 1).

One death occurred because the individual asphyxiated due to Freon™ exposure.

Another death occurred when an individual fell from the dock, intoxicated by alcohol.

The third death (not in temporal order) occurred because a vessel was overloaded (Table 1).

Vessel Description	**Average**	**Range**	
Length (feet)	81	60 - 108	
Crew Size	3	2 - 4	
Year Built	1971	1962 - 1979	
Types	Salmon tender and not fishing at the time		
Vessel Hull Material	**Total**		
Steel	3		
Event	**Total Fatalities**	**Number of Crew on Vessel**	**Cause**
Asphyxiation	1	2	Freon
Fall from Dock	1	Unknown	Alcohol
Vessel Disaster	1	4	Overloading

Table 1. A description of all fatal events and vessels involved in fatal events on tender vessels ≥ 50 feet in length between 2000 and 2012 in the 17th Coast Guard District. Based on data from the NIOSH APO.

3.2 Non-Fatal Events

3.2.1 Overview

Between 2000 and 2009, the NIOSH Alaska Pacific Office reported that there were 21 tender vessel casualties that did not end in fatalities. The average vessel year-built was 1963 with a range from 1920 to 1998 (Table 2). The average crew size was 3 with a range from 1 to 6 individuals, and the average length was 81 feet, with a range of 50 to 165 feet (Table 2). Eighteen of these vessels were operating as salmon tenders, 1 was tendering herring, 1 vessel was fishing for sea cucumbers and transporting their catch and the catches of others to town,[2] and the operations of one vessel are unknown (Table 2).

[2] This instance of “tendering” is different from the classic definition of a tender vessel. While they may have been tendering cucumbers in a broad sense, the activities aboard this vessel were not typical of the tenders in the Alaska Independent Tendermans Association (AITA).

Ten of the tenders involved in non-fatal events were made of steel, 8 were made of wood, and 3 were made of fiberglass (Fig. 1).

Vessel Description	Average	Range
Length (feet)	81	50 - 165
Crew Size	3	1 - 6
Year Built	1963	1920 - 1998
Types	Salmon (18), Herring (1), Cucumber (1), and Unknown (1)	

Table 2. A description of all vessels involved in non-fatal events on tenders ≥ 50- feet6 in length between 2000 and 2009 in the 17th Coast Guard District. Based on data received from the NIOSH APO.

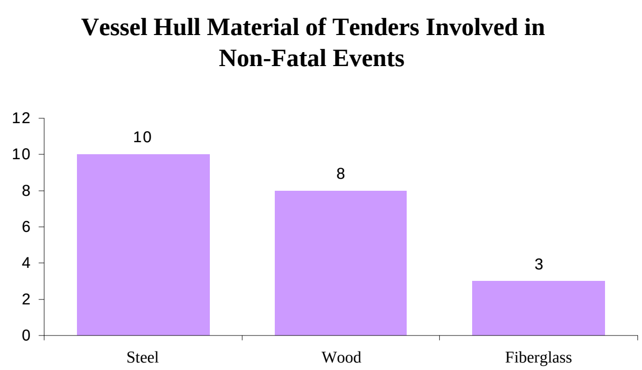

Figure 1. Vessel hull material of tenders involved in non-fatal events between 2000 and 2009. Based on data received from the NIOSH APO.

3.2.2 Events

Striking rocks or the ocean floor was the most common occurrence in the non-fatal events and accounted for 8 out of 21 (≈38%) accidents. The second most common incident was fire or explosion, accounting for 5 (≈24%) events, while 4 (≈19%) vessels experienced flooding. Less predominant causes of non-fatal events included collision/allision (3 vessels, or about 14%) and being struck by a large wave (1 vessel, or about 5%) (Fig. 2).

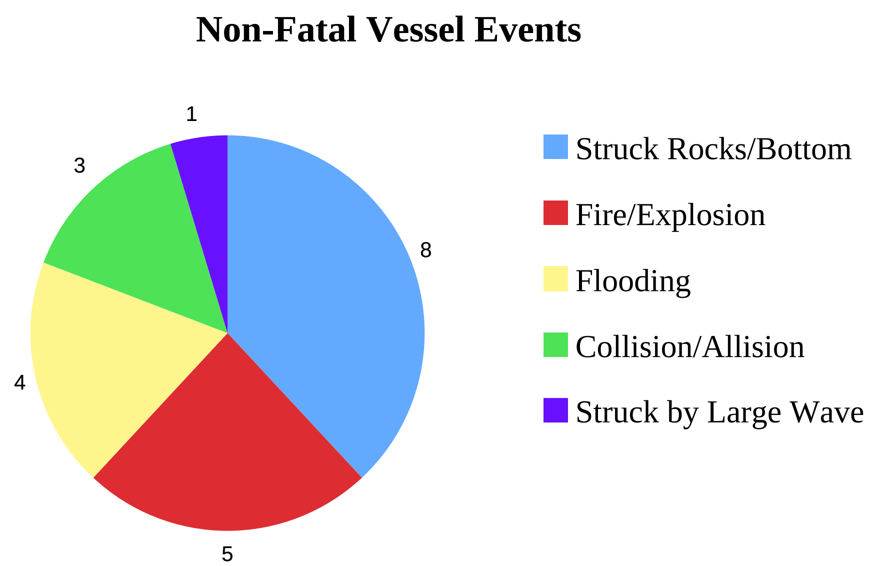

Figure 2. Events resulting in a non-fatal tender accident between 2000 and 2009. Based on data received from the NIOSH APO.

3.2.3 Human Error

Human error accounted for 12 of the 21 non-fatal tender accidents. Of these 12, 7 (≈58%) reported a human error of falling asleep at the helm, 3 (25%) reported drug use, and 2 (≈17%) reported a navigational error (Fig. 3).

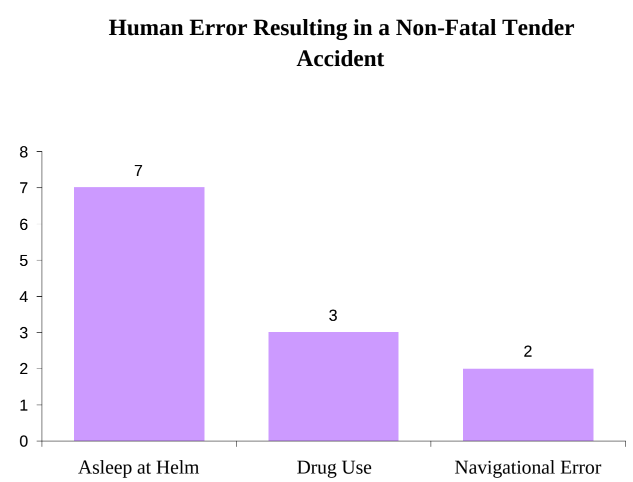

Figure 3. Human error resulting in non-fatal tender accidents in Alaska between 2000 and 2009. Based on data received from the NIOSH APO.

3.2.4 Human Error and Resulting Event

In 5 out of 12 (≈42%) human errors, the operator fell asleep at the helm and struck rocks or the ocean floor. The 3 instances of drug use (25%) also led to the vessel striking rocks or bottom, as did 1 navigational error (≈17%). There were also 2 events (≈17%) where the operator fell asleep at the helm, which resulted in a collision or allision event (Fig. 4). Therefore, all of the reported human error events resulted in the vessel striking something, causing boat damage.

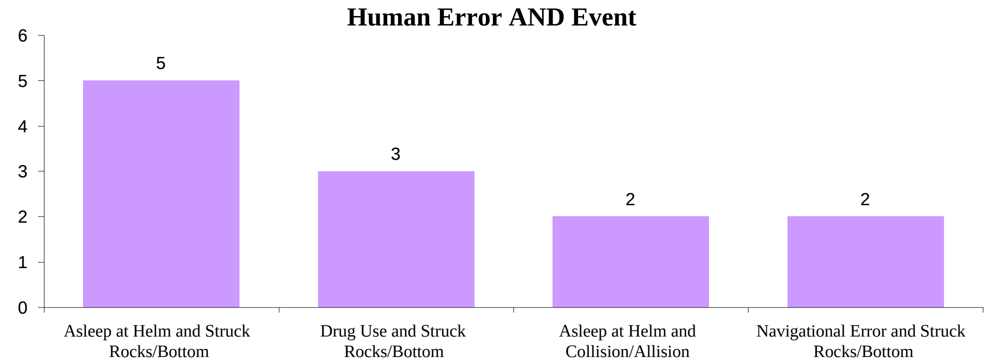

Figure 4. Reported human error and the subsequent event aboard tender vessels between 2000 and 2009. Based on data received from the NIOSH APO.

3.3 Current Tender Operations and Expenses

3.3.1 Tender Dimensions and Operations

Thirty-two tenders across Alaska generously provided information regarding their current expenses and practices. These vessels had an average year-built of 1956, with a median of 1946 and a range of 1918 to 1987 (Table 3). The average vessel length was 89.2 feet, with a median of 83.5 feet and a range of 54 to 124.6 feet. Also, the average maximum crew size was 4.6 individuals with a median of 4 and a range of 3 to 8 people (Table 3).

The majority of vessels were made of steel (20, or 62.5%), while 11 (34.4%) were made of wood, and 1 was made of fiberglass (3.1%) (Table 3).

These tenders spent an average of about 89 percent of their total yearly operations tendering, with 99 percent as the median time. The most common reported percentage for this variable was 100, and values ranged from 25 to 100 percent (Fig. 5).

Vessel Description	Average	Median	Range
Length (feet)	89.2	83.5	54 - 124.6
Maximum Crew Size	4.6	4	3 - 8
Year Built	1956	1946	1918 - 1987
Vessel Hull Material	**Total**		
Steel	20		
Wood	11		
Fiberglass	1		

Table 3. Reported data from 32 current tenders regarding vessel dimensions and materials (2013). Based on data received from AITA.

Some tender operators reported other uses for their vessels, including commercial fishing, hauling freight, and surveys.[3] Nine out of 32 tenders reported fishing commercially. These 9 tenders spent an average of 35 percent of their time commercial fishing, with a median of 10 percent. Additionally, 8 out of 32 tenders reported hauling freight throughout the year, with an average time spent hauling freight of 7.8 percent and median time of 5 percent. One tender reported spending 2 percent of their year completing surveys (Table 4).

Activity	Number of Vessels	Average Time (%)	Median Time (%)
Commercial Fishing	9	35	10
Hauling Freight	8	7.8	5
Surveys	1	2	2

Table 4. Average time spent by tenders on other activities as reported by 32 AITA tenders in 2013. 100% equals the full year. Based on data received from AITA.

[3] A company or agency may charter a vessel to do research (survey). Fish and wildlife agencies do this to learn about sea life populations to accurately set fishing quotas for the coming year (Duz, 2014).

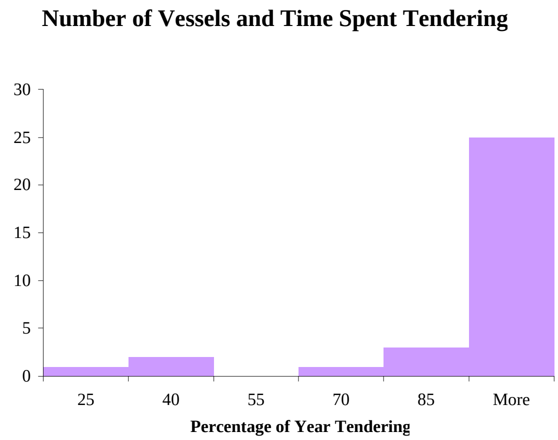

Figure 5. Reported time spent tendering of tender vessels in Alaska in 2013 (100%=total operational time, n=32) (25=0-25%, 40=26-40%, more=86% or more, etc.). Based on data received from AITA.

3.3.2 Income and Expenses

Twenty-seven vessels reported their gross income from tendering operations. They reported an average of $258,777 and a median of $250,000. These gross incomes ranged from $21,000 to $600,000 (Table 5).

Thirty vessels also reported their annual maintenance budget.[4] Of these vessels, the average budget was approximately $51,200, with a median of $50,000 and a range of $15,000 to $120,000 (Table 5).

	Average	Median	Range
Gross Income	258,777	250,000	21,000 - 600,000
Maintenance Budget	51,200	50,000	15,000 - 120,000

Table 5. Reported gross incomes from tendering operations (n=27) and annual maintenance budgets (n=30) of current tender vessels in Alaska (in dollars). Based on data received from AITA.

[4] Some vessels reported a range of values. In these cases, the average of the values was used to compute the average and median. For example, if a vessel reported a maintenance budget of $30,000 to $50,000, $40,000 was used to compute the averages.

4 DISCUSSION

The deaths and vessel casualties aboard tenders arose from a number of different causes, and this chapter proposes individual solutions for each type of casualty category. First, solutions and potential regulation for the fatal events are proposed, followed by the non-fatal events, taking into consideration the AITA survey data completed by individuals in the fleet. The AITA data (Section 3.3) indicate that most tenders spend the vast majority of their year tendering, and also that their incomes (and associated maintenance budgets) from these operations are usually quite limited. In light of that, the potential economic impact of each regulation was assessed before the regulation was recommended in this report.

Finally, the current Alternative Compliance and Safety Agreement implemented in the catcher/processor fleet is reviewed, taking into consideration the feasibility and usefulness of this regulation as it relates to the tender fleet. Ultimately, the accident frequencies in each category experienced by tenders are very different from other fleets, and the proposed solutions therefore reflect the individualistic nature of the risks at hand.

Throughout this entire analysis, it is important to remember the financial situation of most tender operators. While both tenders and regulators understand that safety is a primary goal, regulation that puts many tenders out of business should also be a primary concern. The new alternative regulations must find a balance between improving safety and allowing operations to continue despite minor hazards.

Additionally, the alternative compliance measures should not be subjective measures in which a member of the Coast Guard dictates what they feel is best in a specific instance, but an objective system that tenders can budget for year by year. This will help tenders allocate time and money to projects without being surprised by new, expensive repairs. An untimely and unexpected repair could easily cost a tender operator more than their business is worth, and it is therefore important that regulators and the writers of regulation adhere to a structured, predictable, step-by-step plan that all tenders can allocate resources towards. This will greatly reduce the potential for economically devastating impacts of the new regulation.

4.1 Fatal Events

Between 2000 and 2012, there were only 3 reported deaths aboard tender vessels in Alaska. This number is relatively low, considering that there were 107 total deaths aboard fishing industry vessels in Alaska between 2000 and 2009 (Lincoln & Lucas, 2011). Also between 2000 and 2009, the Bering Sea Aleutian Islands (BSAI) fleet experienced 12 fatalities and the Alaska salmon industry experienced 39 fatalities (Lincoln & Lucas, 2011). While other fleets, such as the Bering Sea Aleutian Islands (BSAI) crab fleet, have already undergone substantial changes in their safety policies because of their high death rates, the comparatively infrequent deaths in the tender fleet have helped slow the charge toward alternative regulation. This is perhaps the most striking contrast between the tender fleet and all fishing fleets, the consequences of vessel casualties. When a vessel casualty occurs on a tender vessel a fatality results about 12% of the time; however in stark contrast, when looking at vessel casualties for vessels in the fleet as a whole, a fatality resulted 91% of the time (Dickey, 2011). When something goes wrong on a fishing vessel, someone is probably going to die. When something goes wrong on a tender vessel, it is unlikely that the result will be death.

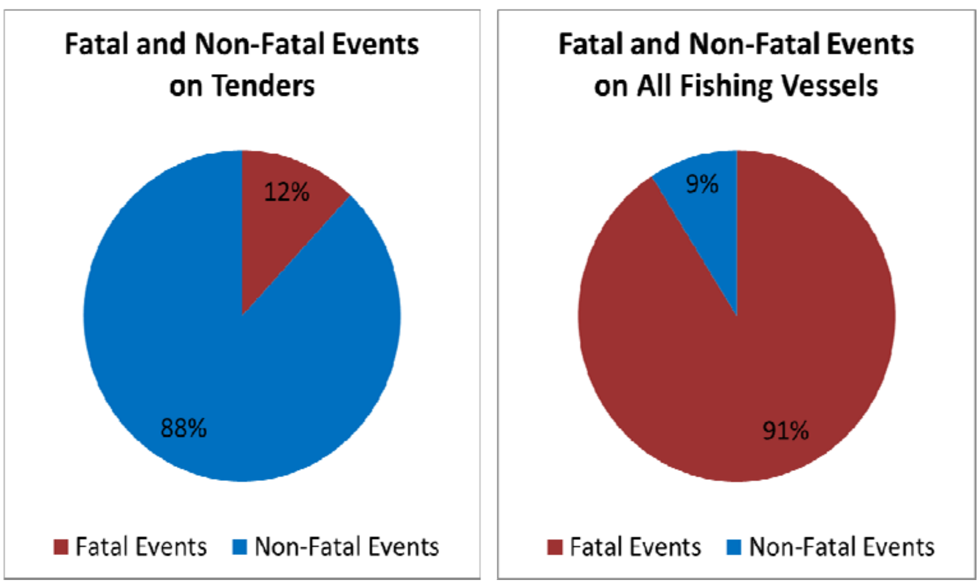

Figure 6. Comparison of Fatal and Non-Fatal Events on Tenders and on All Fishing Vessels.

Yet alternative regulation is imminent, and the new regulations should therefore reflect the real threats in this unique segment of the industry. It is important to remember that these deaths were preventable, and where possible simple, cost-efficient measures should be taken to significantly reduce these risks in the future.

4.1.1 Freon™ Exposure

Freon™ is a type of refrigerant used aboard most tender vessels to keep fish cold during their journey from the fishing vessel to the processing plant. Freon™ is a chlorofluorocarbon (CFC) trademarked by DuPont that comes in many molecular structures, the most common of which aboard fishing industry vessels is currently HCFC-22 (Chlorodifluoromethane) (Duz, 2014).[5] Freon™ is a heavy gas that displaces oxygen when it enters a space, and when people are exposed to it, leads to heart arrhythmia or asphyxiation if an individual remains in the contaminated area. Unfortunately, death due to Freon™ exposure can happen in many different industrial workplaces, often when an individual enters a confined area without proper protection or without knowing that the area is contaminated. The Center for Disease Control (CDC) reported 12 deaths in the 1980s due to Freon™ exposure on land (Miller, 1989), and this refrigerant is a persistent threat in the fishing and fish processing industries (Duz, 2013).

In the AITA survey, 27 out of 32 vessels reported using some type of Freon™ and only one reported using ammonia. Although Freon™ can be lethal, simple measures can be taken to significantly reduce the risk of harmful exposure. Freon™ detectors can be installed in at-risk areas with a readout panel in a remote location to warn employees and operators when there is a dangerous leak. These devices can be installed for $600 to $900 per sensor, and the readout panels cost approximately $1,300 (Duz, 2013). Compared to other repairs and expenses, these detectors are quite affordable, and they are a very effective way of reducing the risk of Freon™ exposure.

Freon™ exposure is a serious issue in many industrial workplaces, and the risk of death should therefore be taken seriously. Having detection in place would likely have prevented 1 out of 3 of the fatalities that occurred in tendering fleet from 2000 to 2012. Freon™ detectors aboard tender vessels will surely prevent future deaths, and they should be required in all tenders that use Freon™ as a refrigerant.

[5] Although DuPont has trademarked Freon™, other companies manufacture refrigerants with the same molecular formula and market them under different names. Freon™ is used in this report for readability and because it is the nickname for all of these types of refrigerants in the industry.

4.1.2 Fall from Dock, Intoxication

One individual in this study died because they fell from the dock, intoxicated by alcohol. Realistically, regulating alcohol consumption by commercial and recreational fishermen is an extremely complex topic and cannot be adequately addressed in this report. The Occupational Safety and Health Administration (OSHA) (and in some cases state occupational safety and health agencies) generally regulates safety on docks. However, alcohol consumption usually occurs during non-working hours and is thus outside the scope of occupational safety regulators' enforcement. Proposing specific regulations for the tender fleet related to incidents of this type is therefore unproductive, as the nature of this death is beyond the scope of this analysis. Even so, a simple solution to prevent similar fatalities is to require the use of PFDs when crew are boarding and disembarking a vessel. Requiring PFD use for the fleet is an elegant solution for many types of problems.

4.1.3 Overloading

Overloading, which resulted in one death in this study, is another preventable occurrence. Overloading occurs when a vessel carries too much weight or carries too much weight above the waterline, which destabilizes the vessel and significantly increases the risk of capsizing and downflooding. These events are usually a result of a human error when an operator makes poor decisions and destabilizes the vessel. Thus, the most important and useful way to avoid overloading is to limit unwise management decisions made by operators. However, other measures may also be taken to reduce the risk of overloading and encourage safe practices. Some of these potential regulations are described below, but it is important to keep in mind that the best decisions will involve the ideas and efforts of many parties.

In some other fishing fleets, vessels are required to undergo stability analyses, in which an outside party calculates the amount that the vessel can safely load onto their vessel without significantly increasing the risk of capsizing. However, these stability tests are expensive. A single test can cost $25,000, which is almost half of the average yearly maintenance budget as reported by AITA tenders. While 20 out of 32 vessels in the AITA survey reported having completed a roll or stability test, more than half of those tests occurred before 1991. Usually, new stability tests are required whenever a vessel undergoes a significant modification, and since some tenders have made significant changes to their vessel, many existing stability tests are likely of no use now. Thus, even though about two-thirds of reporting tenders have completed a stability analysis at some point in the past, most will need to complete a new one, and many current owners may not be able to do so because of the test's associated economic burden.

Putting tenders in financial jeopardy as a result of requiring stability tests would not only be detrimental to the tender fleet but also to those who depend on tenders for their services (including fishing vessels and processors). Therefore, if the Coast Guard determines that some type of stability test is necessary, it should seek to create an alternative to the traditional stability test. This test should be cost-effective, and it should provide some flexibility in operations for tenders. It may prescribe how much a tender vessel can load on board, but it should not require the full mathematical analysis required for other fleets. Rather than being an extremely rigid, strict system, the analysis should leave some room for operations to continue despite small hazards on vessels. This would be a more proportional response considering that stability was a factor in only 1of 24 (4%) total incidents in the tender fleet.

It is also important that the requirements are phased in over time to allow tenders to adjust to the new financial and operational demands of the regulations. Implementing a stability test in a matter of two years (a very short time frame) would cause unnecessary burden on tenders, unnecessary because the data does not support overloading as a major cause of vessel casualties. Although some sort of stability test may be inevitable, the test's design should take into account the economic challenges faced by the fleet. To preserve this vital part of the fishing industry, achieving the balance between utility, efficacy and cost must always be a primary goal.

Another alternative to a traditional stability test might be regulation that dictates where tender vessels can operate without a stability test. One of the longest and most dangerous voyages that tenders undergo is the trip across the Gulf of Alaska, (Duz, 2014). This is an especially dangerous crossing because of its length and exposure, as well as the fact that other vessels may not be available to come to the rescue if problems arise.

Regulating tender voyages across this body of water may help reduce the risks associated with overloading, and there are many options for increasing safety in this way without requiring costly tests and analyses. First, the Coast Guard could require tenders without a current stability report to make this crossing without loads on deck, thus improving stability. Alternatively, they could require tenders to either make this crossing simultaneously with another vessel or operate within a designated distance from shore. These measures might allow tenders to continue to operate in safer more protected waters without costly regulation. Of course, dangerous waters are still a serious threat along shorelines and a vessel may still encounter trouble in these areas, but the increased protection from proximity to sheltered and more trafficked areas make coastlines comparatively safer for voyages.

The Coast Guard could enforce these rules by accessing a vessel's Automatic Identification System (AIS), which tracks the vessel and allows others to view its location. Since all tender vessels either already have AIS systems or will be required to use them in the near future (Lee, 2014), this would not be an added cost to tender operators, making this type of regulation both effective and cost-efficient.

Again, while the suggestions described above may help avoid overloading disasters, the most important factor in these accidents is the human factor. The ultimate solution to avoiding overloading casualties and fatalities is proper decision making by the operator, and their knowledge and experience is key. Even though solutions with a price tag are appealing when forming regulation, it is important to remember that, in many cases, the operator is the most important variable in the analysis.

4.2 Non-Fatal Events

The challenges experienced by the Alaskan tender fleet are much different than those of the greater fishing vessel population. Data of all non-fatal vessel losses in Alaska and the West Coast between 2000 and 2010 indicate instability was a factor in 11 out of 129 (9%) non-fatal events in Alaska fisheries at large (Lincoln *et al.*), whereas this was *not a factor* in non-fatal events on tenders (0 out of 21 non-fatal events). Similarly, 35 out of 126 (28%) non-fatal events on fishing vessels occurred because the vessel struck bottom or rocks (Lincoln *et al*.), whereas this occurred in 12 out of 21 (58%) events aboard tenders.

In the USCG analysis by Dickey in 2011, which incorporates a longer date range (1992-2010) the data provides an even greater contrast to that of tender vessels alone. All fishing vessel collision/allision and grounding accidents drops another 5 percentage points to 23%, compared to 58% for tender vessels. More than twice as often as fishing vessels, tender vessels are running into something. Clearly the risks for tenders are different. The regulation must be focused where tenders are actually at risk.

Yet another way in which the tender fleet risks differ from those of fishing vessels is the casualty due to flooding category. In fishing vessels at large, flooding was a cause in 36% of vessel incidents, whereas for tender vessels it is almost half that much of the time, or 19%.

It is clear from these comparisons alone that tenders require specific regulations that will help mitigate issues that pertain directly to this fleet. Without modification, applying the current ACSA program or the regulations that are used in the BSAI crabbing fleet would be ineffective and fiscally burdensome for tender operators, and needlessly so. Risk based solutions for each type of vessel casualty are discussed individually (striking rocks/ocean floor, fires/explosions, flooding, collision/allision, and struck by large wave), as well as the human errors that resulted in casualties (falling asleep, drug use, and navigational error).

4.2.1 Striking Rocks or the Ocean Floor

The largest proportion of vessel accidents occurred because a vessel struck rocks or the bottom of the sea floor (8 out of 21, or 38%). These types of incidents are usually due to human error, and solutions to these issues are proposed in the *Human Error* section (Section 4.3.1) under *Falling Asleep At Helm*.

4.2.2 Fire and Explosion

The second most common type of vessel casualty was fire or explosion, accounting for 5 out of 21 (≈24%) events. Warning signs are often present before these serious events occur and although the data in this report do not show the cause of these incidents, fires and explosions are often due to the human errors of neglect and poor maintenance. The solutions to causes such as these are generally simple.

The Coast Guard could therefore implement simple, cost-effective regulations that would mitigate the risk of fires and explosions aboard vessels. These requirements may include an annual inspection of the sleeving on fuel hoses, hydraulic hoses, and fittings on these hoses to reduce the risk of fire. In addition, the regulation may also require proper storage of flammable materials, (for example, away from the engine) the use of metal flooring on steel vessels (as opposed to wood which ignites easily, especially when soaked with oil), and/or a visual inspection of electrical wiring and equipment.

These are all general maintenance procedures that necessitate proper attention, without which the risk of fire and/or explosion increases.

Additionally, most tenders must already undergo periodic surveys as required by their insurer. This means that the vessels are already being inspected for some issues, and requiring additional inspections would be feasible. Twenty-six out of 32 tenders in the AITA questionnaire replied that their insurer required periodic surveys, while only 6 responded that surveys were not required. Most of the tenders were required to complete a survey every 2 to 4 years, with a range of frequency from 1 to 5 years. While an inspection every 5 years may be insufficient, tenders are already accustomed to the process, and regulators should therefore consider implementing additional inspections or broadening the scope of the current inspections to reduce fire and explosion risks.

Although fires and explosions can likely be avoided by paying attention to general maintenance without serious financial burden, extra measures may be necessary if these options prove inadequate. Subsequent regulation could require some crewmembers or operators to participate in basic fire prevention and fire fighting classes to enhance fire safety knowledge, and these classes would be a relatively inexpensive solution. While these classes are often helpful, it will also be important to specify who must be trained, because it would likely be impractical to require every member aboard the vessel to complete a training course. To a great extent, nature dictates the season start date for the tender fleet and often without much warning. As with other fishing fleets, many crewmembers come to work the summer in Alaska from distant locations.. Given this level of unpredictability crewmembers usually do not have time to participate in a fire prevention class before boarding a vessel and the classes are rarely offered near their hometown and/or at necessary times. Thus, requiring every member aboard the vessel to complete a course would place a logistical and economic burden on the tender. It may be more feasible, then, to require certain key operators or managers to complete a course so that their knowledge can be applied to the vessel. Therefore, while fire prevention classes could be a helpful solution to tenders' issues, it would be important to specify who must complete the training.

More advanced fire suppression systems are also available if fire and explosion incidents persist. A fixed system, which generally puts out a fire in a closed space by filling the room with a gas or chemical extinguishing agent, is a more sophisticated type of firefighting equipment that requires airtight spaces to be effective (United States Department of Labor, 2014). In fact, some tenders have already implemented this technology. In the AITA survey, half (16) of the tenders reported having fixed fire systems.

However, fixed systems have serious drawbacks, and since installing a fixed system can cost an operator thousands of dollars, other regulatory standards should be implemented before resorting to these measures. When a fixed system is activated, the entire vessel must be shut down without power for hours, leaving it adrift until the engine room may be safely accessed again, posing new hazards to the vessel and crew. Fixed systems do not prevent fires, they only mitigate them once they have already occurred. Furthermore, fixed systems are not always effective. Ultimately, these systems should not be the first line of defense in fire prevention or fire fighting aboard tender vessels. Preventive actions, such as routine maintenance procedures and the use of appropriate construction materials, are generally much more effective, and serve to prevent the fire from occurring in the first place. The construction of wooden boats can make the installation of these systems infeasible. The engine rooms are often fully open to all other below deck areas and cannot be feasibly sealed off, which is necessary to the function of a fixed system.

Thus, the Coast Guard should implement a compliance checklist for tenders to follow to reduce their risk of fire and explosion. The associated inspection should be at clear time intervals with very little room for inspector interpretation or subjectivity, and if the vessel does not comply with the checklist they should be given time to perform the maintenance to bring them into compliance. If this type of regulation is not effective in reducing fires and explosions, the Coast Guard and operators could consider extra measures such as additional fire prevention courses, fire fighting training, or the installation of fixed systems. In the case of fire and explosion, the simple preventive solutions achieve the balance between utility, efficacy and cost.

4.2.3 Flooding

Four out of 21 (≈19%) tender vessel casualties involved flooding. While flooding can have disastrous consequences for both the vessel and those aboard, there are many simple steps that owners and operators can take to significantly reduce their chances of experiencing a flooding event. Similar to the previous section on fires and explosions, the Coast Guard could effectively use a checklist of general maintenance procedures to vastly improve vessel safety.

Vessels can flood as a result of failed through-hull fittings or downflooding. Downflooding occurs when an initiating event, such as a failed watertight hatch, or a rogue wave leads to water entering one or more of the ships compartments (Duz, 2014). Water from that flooded area then progressively enters other spaces on the vessel, ultimately leading to a large flooding disaster. Luckily, there are simple, routine maintenance procedures that reduce the risk of downflooding as well as other types of flooding. The Coast Guard, along with other involved parties, should therefore formulate a checklist much like the one proposed in the *Fire and Explosion* section (Section 4.2.2). This checklist should include inspecting the vessel's hull materials for watertight integrity, and it should also ensure that fittings are not corroded and are safe for use. Again, this checklist should be an objective list that tenders can follow year by year, and it should also have steps to be implemented over a substantial period of time (multiple years) in order to dissipate the financial impact.

Since tenders are often older vessels converted from fishing boats they may use something called a "doubler" to reinforce the hull, which may also pose a flood risk. A doubler is often installed when a piece of steel on the hull of the vessel rusts and corrodes and becomes weak. Instead of replacing the steel with a new piece, some operators layer a piece of steel on top of the old one to reinforce the hull. In general, this is not the safest solution to these issues, but it is much more cost-effective and allows operators to continue operating. In the AITA survey, there were 20 steel tender vessels. Of those, 11 reported using doublers. When polled about what percentage of their hull was covered in doublers, values varied greatly, ranging from 1 percent to 80 percent.

Replacing these doublers with new hull plating would be ruinously expensive. Seattle shipyards typically charge $2,000 to repair a small 12 inch by 12 inch section, and a full sheet of steel may cost as much as $50,000 to replace (Duz, 2014). The prices vary greatly based on the location and condition of the vessel structural members, too. For example, if fuel tanks are involved and must be gas freed,[6] or if equipment must be removed and reinstalled, prices increase. These potential repairs have very high costs that could put many tenders out of business, considering that the median annual maintenance budget for tenders is about $50,000. Yet some regulators might suggest that tenders replace their doublers to reduce their chances of flooding. However, this opinion is just that, an unsupported opinion,

[6] Before performing repairs around or near a confined space, especially a fuel tank, the space must be cleared of all combustible gases and liquids. These procedures become expensive quickly, as the tanks are usually drained, cleaned, and then filled with an inert gas so that the welder does not cause an explosion.

not risk based. The casualty data do not show that tenders need to undergo such an expensive process, as there were no cases of doubler failure reported in the data of tender casualties.

Thus, similar to the solutions suggested in the *Fire and Explosion* section, simple, cost-effective measures should help decrease the number of tender vessel casualties due to flooding, and these solutions should therefore be given first priority. Requiring all doublers to be replaced would be an instance of using a cutting torch when what is needed is a scalpel. In addition, it would only solve a problem that did not occur in the data set, therefore failing the test of utility and efficacy as well as cost. Just as in the case of fires and explosions there are better solutions that improve safety while allowing continued operations. Precious maintenance dollars would be much better spent on the real risks faced by tenders.

4.2.4 Collision and Allision

There were 3 vessels (≈14%) that experienced collision or allision (an instance where a vessel strikes a fixed object) events. Collision and allision often arise due to the same issues in the *Striking Rocks or the Ocean Floor* and *Navigational Error* sections, and the same solutions are therefore proposed. These suggestions can be found in the *Human Error* section (Section 4.3.1) under *Falling Asleep at the Helm* and the *Navigational Error* section (Section 4.3.3). Solutions that keep watch people awake and alert and solutions that enhance navigational knowledge are likely the same solutions that would help reduce these collision and allision events, and they should therefore be strongly considered to prevent tender accidents in the future.

4.2.5 Struck by Wave

There was one instance in this report where a vessel was struck by a large wave. While this may be considered a "freak accident" and there may not be a realistic solution to address this isolated incident, there are simple measures that operators can take to reduce the risk of harm if their vessel is struck by a wave. These solutions have already been discussed in this report, and they are discussed in more depth in the *Overloading* section (Section 4.1.3) of the *Fatal Events* section.

4.3 Human Error

4.3.1 Falling Asleep at the Helm

Falling asleep at the helm was the most commonly reported human error (7 out of 12 instances). These errors resulted in the vessel either striking rocks or the bottom (5 out of 7) or a collision or allision event (2 out of 7). Therefore, to prevent many of the non-fatal events that occur, finding a way to keep individuals alert and awake at the helm would be a very advantageous solution. Operators in the tender fleet are especially susceptible to falling asleep at the helm because of the long hours and limited staff on board. Tenders often spend all day and night receiving fish deliveries and traveling from one location to the next, and when the crew size is small (2-3 individuals), the long, monotonous hours and rolling seas can lull even the most caffeinated individual to sleep. Luckily, there are many cost-effective solutions to keep operators awake at the helm.

Watch alarms, also called bridge alarms or bridge navigational watch alarm systems, are one of the most effective ways to ensure that operators remain alert. These inexpensive pieces of equipment generally display a local signal (often in the form of a flashing light) at designated time intervals where the operator is located. The operator must then switch off the alarm, usually by pressing a button or moving his arm in front of the sensor, indicating that he or she is alert and awake. If he or she does not switch the alarm off, however, a louder alarm will sound, waking him and/or other vessel employees. Safety of Life at Sea (SOLAS), an international maritime safety treaty to ensure basic vessel safety, recently required that watch alarms be used in passenger and cargo ships (with a phase-in period ending in 2018) to address similar issues aboard different vessels (Germanischer Lloyd, 2013). While the price of these systems varies, the cost is generally about $2000 for the equipment, which is a relatively low cost for the longevity and utility of these safety systems.

Yet tenders do not frequently report using watch alarms. In the AITA survey, only 5 out of 32 vessels reported using such systems, a surprisingly low number. Because the data show that tender watch standers are indeed falling asleep at the helm, mandating the installation and use of watch alarms would be an advantageous solution for tenders. Additionally, it may be beneficial to require these alarms to be linked to the vessel’s autopilot and general alarm systems. Since the risk of falling asleep is the greatest when the vessel is running on autopilot, keeping tender operators awake during this critical time would reduce the number of these needless accidents. Further, connecting the alarm to the general alarm system would help notify all other crewmembers of potential emergencies before they have serious consequences.

Since collision/allision and grounding accounted for the largest proportion of all vessel disasters (58%), and of the recorded human errors, falling asleep accounted for over half (≈58%) of these striking-rock incidents and also all of the collision events, keeping tender operators from falling asleep would likely be one of the most effective solutions to reducing vessel casualties in the tender fleet. The tender fleet and USCG should seriously consider requiring the use of watch alarms to help mitigate tender casualties, especially considering how cost-effective these solutions are.

4.3.2 Drug Use

Drug use accounted for 3 out of 21 (14%) non-fatal events, and all 3 of these events resulted in the vessel striking rocks or the ocean floor.

Unfortunately, the data studied in this thesis are insufficient to reach a conclusion and propose solutions for reducing drug use onboard tenders. It is not possible to distinguish in the data between types of drugs used, including the distinctions between illegal substance abuse and alcohol consumption. Additionally, tenders face other logistical challenges, including a limited number of employees onboard and lack of administrative oversight and support. This suggests that proposing drug use regulation, even if this data better described the incidents, would pose great logistical challenges from an implementation standpoint. Essentially, the shortcomings of the data set and realities of tendering make any potential regulation related to drug use an ineffective use of resources.

Whereas, it would be much more advantageous to impose more realistic measures, such as requiring watch duties to be performed with an effective watch alarm. Watch alarms, which keep an individual alert and notify others if that individual has failed to do their duty, will likely significantly reduce the risk of the most common type of incidents that tenders face. Thus, while not directly addressing drug use with regulation, the consequences of the drug use as revealed by the data, namely striking rocks and the ocean floor, can be addressed.

4.3.3 Navigational Error

There were 2 instances (≈16% of the total human errors) of navigational error in this data set, both of which led to the vessel striking rocks or bottom. This is a much less predominate type of human error in the fleet, but simple measures can be taken to reduce the risk of navigational errors. For instance, the USCG could require some operators or watchmen to complete navigational classes to increase their knowledge of general operational procedures and navigation techniques. Similar to the discussion on firefighting and fire prevention classes in the *Fire and Explosion* section (Section 4.2.2), it would not be feasible to require *all* employees aboard a tender vessel to complete courses in navigation because of their temporary employment and place of residence. However, it is important that at least some members of the crew have a thorough understanding of proper navigational practices. If some operators have completed a course and are competent in their skills, it would be beneficial for them to train other individuals on the vessel to increase general safety. Navigational errors were only reported twice in this data set, but navigational classes for some specific employees would be a simple, effective solution to reducing these errors.

4.4 Current Alternative Compliance and Safety Agreement

The current Alternative Compliance and Safety Agreement (ACSA), used by the catcher/processor (C/P) fleet, is a lengthy document with many requirements. While some of the regulations may be helpful for increasing safety and staff competency, many of the measures are very expensive and would not adequately address the risks faced by the tender fleet as identified in this data set. It would therefore be very ineffective to simply implement this program without modification in the tender fleet.

Applying the current ACSA to tenders would put many operators out of business. The catcher/processor fleet has a much greater income than the tender fleet (Duz, 2013), and C/P vessels and owners can therefore afford to make many of the changes required by the agreement. In order for tenders to remain in business, however, they must be allowed to use the least extensive changes necessary for safety, yet ACSA often calls for the most comprehensive maintenance procedures. This would impose an insurmountable financial burden without an equivalent benefit.

Furthermore, ACSA would fail to address many of the challenges faced by tenders. One of the predominant causes of vessel casualties in this data set is hitting rocks or the ocean floor. The expensive maintenance required by ACSA would do little to address this. The regulations proposed in this chapter would be more worthwhile for all involved parties, and regulators should therefore look towards a different type of alternative regulation for the tender fleet rather than modifying the current ACSA document.

CONCLUSION

While this analysis lays a foundation for the future regulation of the tender fleet, the best regulations will arise from a collaborative process between operators, owners, captains, regulators, inspectors, safety experts, and other stakeholders in the tender segment of the fishing industry. The regulations proposed in this report should therefore be understood as *recommendations* or a *starting point* for a discussion, with an understanding that the actual compliance agreement should be reached through a much greater dialogue between the involved parties.

However, this report's findings do lead to some important conclusions concerning the direction of the new regulation. After analyzing the data, and communicating with regulators, safety experts, and tendermen, it is abundantly clear that the current ACSA would not be an advantageous solution to the problems that tenders face. In many cases, it would ruin businesses and destroy family incomes. However, by implementing the solutions proposed in this report for just three categories of the causes of vessel casualties, namely striking rocks or ocean floor (38%), fires and explosions (24%), and flooding (19%) over 81% of the causes of tender vessel casualties could be effectively reduced. This targeted, risk based approach passes the test of balance between utility, efficacy and cost. It allows the people who make their living tendering, to not only survive to work another season, but to thrive, by being able to continue what is a unique and wonderful way of life. Not only do tenders get to work in the most beautiful environment on earth, but the cooperative and supportive nature of what they do is a beautiful way to work. All involved parties should seek to make this way of working even better. Regulators should hold in mind the following factors when contemplating regulations for the tender fleet:

1. The **limited income** of tenders. Tenders have a very limited gross income and maintenance budget when compared to other fleets. Regulators should therefore consider the cost of any potential regulation,
2. The **timetable** in which maintenance is required. Regulations should have a clear, objective timetable of repairs and maintenance to perform. This will allow tenders to budget for maintenance expenses with minimal surprise, *and*,
3. The **objectivity** of inspections and maintenance procedures. Inspectors and regulators *must* remain objective when carrying out inspections. Regulations should not be subject to change

based on an individual inspector's opinions, which could create unforeseen financial burdens for operators.

In addition to these general considerations, and based on the data, the following specific regulations are proposed as a *starting point* to increase worker safety aboard tenders while also allowing most tenders to continue operations. The solutions are arranged from least expensive to most expensive, but they should all be considered to address the accidents that tenders have already experienced. The potential regulations include:

1. An alternative regulation to the stability test, which *might* include one or more of the following: Requiring **vessels without a current stability report** to make **long crossings in pairs and/or stay within a designated distance from shore and/or make crossings without loads on deck,** especially when crossing the Gulf of Alaska.
2. Install **watch alarms** that are linked to both the vessel's autopilot and general alarm systems,
3. Require some vessel operators to complete a **navigational course** before operating the vessel,
4. Create a **routine compliance checklist** to ensure that the vessel is not at risk of **fires and explosions** (to be carried out at designated intervals by a surveyor or an individual from the United States Coast Guard),
5. Create a **routine compliance checklist** to ensure that the vessel is not at risk of **flooding** (to be carried out at designated intervals by a surveyor or an individual from the United States Coast Guard), *and,*
6. Install **refrigerant leak detectors** in spaces that have refrigeration equipment.

Expensive repairs and maintenance, such as replacing doublers or installing fixed firefighting systems, would be financially burdensome for most tenders. Therefore, the less expensive compliance measures should be implemented first and given time to have an effect. If the initial proposed regulations do not adequately address tendermen safety risks and the same problems persist, then other measures may be considered.

Lastly, it is important to remember that tendermen can spend large sums of money on expensive and time consuming repairs, but unless the small, simple issues are addressed (such as keeping operators awake at the helm), progress toward safer operations will ultimately be slow, if not impossible. The greatest return on any investment in tender vessel safety will come from the small, operational changes that are implemented, which will keep tenders in business and maximize their safety. It is therefore of the utmost importance that operators, regulators, and other involved parties work together toward an effective, objective, and cost-efficient regulatory plan for tenders.