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Emergency Towing

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Emergency Towing

An Interactive Qualifying Project
Submitted to the faculty of
Worcester Polytechnic Institute
in partial fulfillment of the requirements for the
Degree of Bachelor of Science



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Abstract

The purpose of this project was to examine the current status of emergency towing vessel response times in regards to the Coast Guard regulation 33 CFR 155.4030 (e). In working alongside Coast Guard personnel, we have developed a comprehensive understanding of issues including the dynamic condition of the tugboat industry, inconsistencies among response methods, and inadequate information available on response vessels. From these findings an automated prototype database was created to improve the efficiency of dispatching an appropriate response vessel with the use of an easily understandable, color-coded output page. In addition, recommendations were included in a final report to further develop the prototype.

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Authorship

This proposal was written with equal input by all team members in every section. Editing and revisions were done on each section by the entire team in order to ensure common ideas, knowledge, and input. For each section, we have listed the original writer(s):

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List of Abbreviations

ABS	-	American Bureau of Shipping
BHP	-	Brake Horsepower
CFR	-	Code of Federal Regulations
CGBI	-	Coast Guard Business Intelligence
CIA	-	Central Intelligence Agency
COTP	-	Captain of the Port
DEA	-	Drug Enforcement Agency
FBI	-	Federal Bureau of Investigation
FRS	-	Fire and Rescue Services
GSA	-	Geographic Specific Appendix
HMCG-		Her Majesty's Coast Guard
HSC	-	Harbor Safety Committee
IACS	-	International Association of Classification Societies
IMO	-	International Maritime Organization
IQP	-	Interactive Qualifying Project
MISLE-		Marine Information for Safety and Law Enforcement
MQP	-	Major Qualifying Project
MSC	-	Marine Safety Center
NM	-	Nautical Miles
OPA 90-		Oil and Pollution Act of 1990
SAR	-	Search and Rescue
SMFC	-	Salvage and Marine Firefighting Companies
SMFF	-	Salvage and Marine Firefighting
SMFV	-	Salvage and Marine Firefighting Vessels
USCG	-	United States Coast Guard
VRP	-	Vessel Response Plan
WPI	-	Worcester Polytechnic Institute

Locations/States

AK	-	Alaska
CA	-	California
DC	-	District of Columbia
FL	-	Florida
HI	-	Hawaii
LA	-	Louisiana
MA	-	Massachusetts
OH	-	Ohio
US	-	United States
VA	-	Virginia
WA	-	Washington

Executive Summary

In the twenty plus years since the Exxon Valdez oil spill in Prince William Sound, Alaska, Coast Guard regulations that fulfill requirements of the Oil Pollution Act of 1990 (OPA 90) have enabled the maritime industry to significantly reduce oil spills in the United States waters. OPA 90 Salvage and Marine Firefighting regulations found in 33 CFR Part 155 Subpart I, were implemented on February 22, 2011, following a lengthy collaboration between the U.S. Coast Guard and the maritime industry. The regulation defines salvage and marine firefighting services, provides timeframes for response, and mandates that tank vessel owners enter into contracts with providers to cover the pollution risks associated with their vessels in each of the Captain of the Port zones where they trade.

Case studies of ship accidents requiring emergency towing response provide evidence that environmental damage and high costs can result when adequate towing vessels are unable to arrive in a timely manner. Emergency towing is one of the 19 salvage and marine firefighting services that vessel owners must plan to provide for their vessels under the new regulations. This study addresses the requirement to provide emergency towing vessels that are adequate to handle particular distressed vessels and operate in winds of up to 40 knots.

The project team developed a prototype emergency towing vessel database that may be used to quickly identify those towing vessels that are adequate for response to a particular distressed tank vessel. Quick winnowing of towing vessels to eliminate those without the characteristics necessary to respond is expected to save valuable time and therefore lives, the environment and property.

Emergency towing vessels included in the database are cataloged using key characteristics such as length, breadth, depth, bollard pull (pulling force). Once information about a disabled vessel and incident location are entered, the database sorts the tugs that are included in the database into three categories:

Green → Meets all conditions

Yellow → Meets ideal weather conditions (might need assistance from additional tugboats)

Red → Worst choice/wouldn't be able to complete the job

This instantly makes it quite clear which tugs are adequate to carry out the towing, as can be seen below;

Qualified Tug List For Distress Situations



SMFF Resource Provider:

All

Green = Meets All Conditions

Yellow = Meets Ideal Weather Conditions

Red = Not Suitable

Print Report

Return

Vessel	SMFF Resource Provider	Company	Contact	BHP	Bollard Pull	Ideal Weather B	Actual BP Needed
DELTA BILLIE	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	6800	133	69	70
DELTA CATHRYN	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	6800	133	69	70
DELTA DEANNA	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	4400	94	69	70
DELTA LINDA	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	4400	94	69	70
GOLIAH	TT Bisso LLC	Crowley Marine Services	(510) 251-7500	4400	94	69	70
Lynn Marie	Marine Response Alliance, TT Bisso LLC	Foss Maritime	(510) 307-7820	6250	85	69	70
NATOMA	TT Bisso LLC	Sause Bros INC	(562) 901-0365	5700	75	69	70
NAVAJO	TT Bisso LLC	Sause Bros INC	(562) 901-0365	5700	75	69	70
PACIFIC FREEDOM	TT Bisso LLC	K-Sea Transportation	(206) 443-9418	4400	70	69	70
NAKOLO	TT Bisso LLC	K-Sea Transportation	(206) 443-9418	5750	69	69	70
COCHISE	TT Bisso LLC	Sause Bros INC	(562) 901-0365	3750	65	69	70
MIKIONA	TT Bisso LLC	Sause Bros INC	(562) 901-0365	3750	65	69	70
Millennium Star	Donjon-SMIT LLC	Harley Marine	(510) 666-5010	4400	64	69	70

Figure 1: Sample Output Form

This is expected to result in more expeditious response.

Background research in the fields of emergency maritime incidents, emergency towing and current classification of tugs was imperative to ensure necessary background information was present to identify and ultimately attain the project goal. In addition to literature review, the project team interviewed marine salvage professionals. This research provided information on classification methods and how tugs were chosen to respond to emergencies. The professionals' opinions of important characteristics were taken into consideration for the organization of the database.

In conclusion, this project required the integration of information from multiple sources to enable the research team to create a database tool that may help solve a problem the Coast Guard and maritime community face whenever there is a need for emergency towing.

1. Introduction

In March of 1989 the Exxon-Valdez oil tanker struck an Alaskan reef spilling over 11 million gallons of oil into the surrounding waters. It was evident the nation was not prepared for a crisis of this size and nature, as clean up efforts proved time consuming and inefficient. As a result Congress passed the Oil Pollution Act (OPA 90) in August of 1990 mandating vessels carrying oil to compose plans to prevent spills as well as to document detailed containment and cleanup arrangements in the event of a spill.

OPA 90 is the basis for many regulations implemented by the United States Coast Guard (USCG), including those put into effect in February 2011 with regards to emergency towing. In the new regulations tank vessel owners should plan to have adequate towing vessels available within 12 hours in nearshore environments (0-12 miles) and 18 hours offshore (12-50 miles). The timeframe starts when the initial call is made and is not always met. Many times unforeseen problems arise, causing a delay in response.

One cause for the slow response times is due to the vagueness of the new regulations, only requiring that the contracted towing vessels include information on the “horsepower,” “bollard pull,” and “proper characteristics”. However, this is not enough information to quickly and efficiently dispatch a response vessel. Many tug companies provide further information in towing vessel specification sheets available on their websites, but it is time consuming to pull them up.

Response Alliance, Donjon-Smit L.L.C., Resolve Salvage and Fire (Americas) L.L.C., and T&T Bisso L.L.C. are the four main companies that work alongside the Coast Guard to respond to these types of emergency situations. Each company is required to submit a Core Geographic Specific Appendix (GSA) quarterly for each Captain of the Port zone. The purpose of these is to ensure each zone has a list of tugs that are contracted to respond to emergency situations. It also includes which companies are contracted with each tug. However, the only characteristics included in these appendices are bollard pull and horsepower. This is not nearly enough information to determine if a tug is adequate.

The goal of this project is to develop an automated decision making tool for the United States Coast Guard and the Salvage and Marine Firefighting Industry, an instrument that will expedite the process in choosing an adequate tugboat to respond to any specific emergency distress situation. This tool was created in the form of a prototype database specifically for the port of San Francisco. This database optimized the response time for the companies in the San Francisco port by efficiently cataloguing tugs according to numerous characteristics. Some examples include;

- Dimensions (length, breadth, depth)
- Vessel service (harbor, coastal, or ocean tug)
- Bollard pull (pulling force related to horsepower)

When an emergency occurs, the location and specifications of the disabled vessel are input into the database and it sorts the tugboats into three categories:

- Green, ideal tug (meets all requirements)

- Yellow, acceptable tug (could tow the disabled vessel in calm weather, but not in the actual weather conditions)
- Red, worst tug (does not meet any requirements)

From the simple outputs, the user can quickly choose an adequate tug according to the specific emergency and find all the necessary characteristics of the tug in one convenient location.

The U.S. Coast Guard recognizes the unfortunate results of the inconsistent documentation and the need for a common method to catalogue emergency response vessels. By creating and enforcing new regulations the Coast Guard hopes to ameliorate any confusion amongst salvage companies and ships in distress. In order to help the project sponsor and attempt to start resolving the issue at hand, this project team researched essential characteristics and the current methods of cataloguing emergency towing vessels. It was decided to create a prototype database for the port of San Francisco that would improve the current process of dispatching tugs. Locating an appropriate tug and salvage company to contact, quickly, would go a long way toward speeding up emergency towing response. Upon completion of this work a more efficient and uniform way to catalogue and dispatch emergency response vessels was identified and now allows faster emergency response times on the water.

2. Background and Literature Review

The United States Coast Guard is in charge of monitoring emergency maritime situations and how they are handled, from the minute the distress call is sent out all the way until the situation has been resolved. When an emergency situation occurs on the water, it is the vessel owner's responsibility to send out response vessels to assist using the contracted Salvage and Marine Firefighting (SMFF) resource provider. These vessels are commonly tugboats equipped with the correct materials to assess and repair the damage, or tow the disabled ship to shore. It is essential this is done as fast as possible. Unfortunately, due to the company's different methods of cataloguing these tugboats, response timing is slower than desired.

In this chapter we will discuss: the U.S. Coast Guard and the four major salvage and marine firefighting companies, salvage and marine firefighting vessels and situations that call them into action, the regulations mandated by the Oil Pollution Act of 1990 and enforced by the U.S. Coast Guard, and then the existing salvage and marine firefighting methods and how other countries tackle the same tasks.

2.1 U.S. Coast Guard

The United States Coast Guard (USCG) is a branch of the United States military that operates within the Department of Homeland Security (See Appendix A for further details on the USCG's structure). The main mission of the USCG is "to protect the public, the environment, and U.S. economic interests — in the nation's ports and waterways, along the coast, on international waters, or in any maritime region as required to support national security" (USCG, 2011c, par 1). This project was conducted in conjunction with two offices of the Coast Guard; The Vessel Response Plan (VRP) Program and the Marine Safety Center (MSC). Both offices work with each other to regulate and assist in emergency maritime distress situations. The MSC provides specific engineering solutions, while the VRP works to create regulations which standardize the emergency response industry (See Appendix A for specific information on the offices).

2.1.1 Locations

The USCG (2011i) has nine district locations in the two regions, Atlantic and Pacific. The Pacific Region is divided into four district offices located in Seattle, WA, Juneau, AK, Honolulu, HI, and Alameda, CA. The Atlantic Region is divided into five district offices located in New Orleans, LA, Boston, MA, Cleveland, OH, Portsmouth, VA, and Miami, FL. The USCG Head Quarters is located in Washington, D.C. Figure 2 shows the different USCG locations and regions. Each of these offices is located on or near major bodies of water under U.S. control. The main reason for the locations of these district offices is that the country is extremely large, and it would be very difficult to maintain security and safety for everyone on the water if there were only one Coast Guard command location.

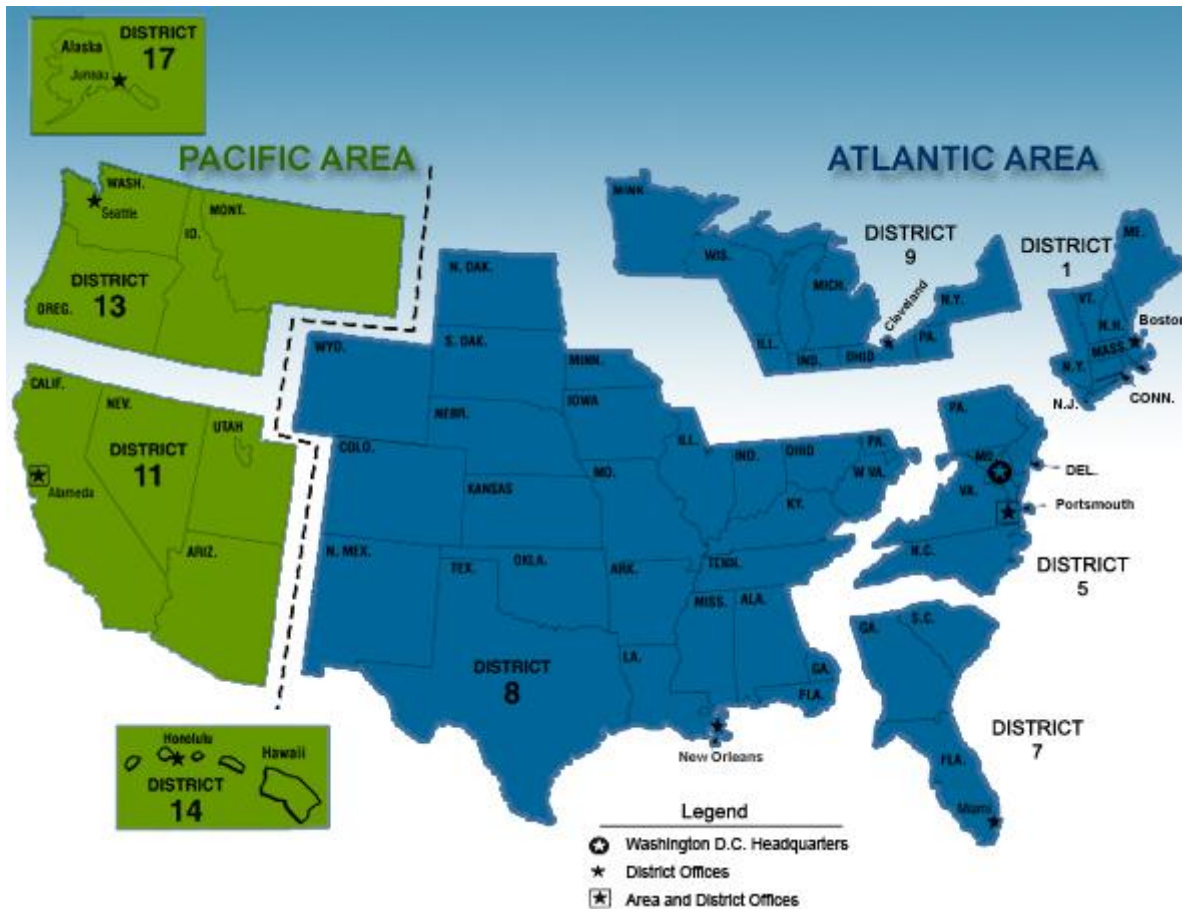


Figure 2: U.S. Coast Guard Districts (U.S. Coast Guard, 2011i)

2.1.2 Missions and Divisions

The United States Coast Guard (2011g) has many responsibilities, which they accomplish through their eleven core missions:

- Ports
- Waterways
- Coastal security
- Drug interdiction
- Aids to navigation
- Search and rescue
- Living marine resources
- Marine safety
- Defense readiness
- Migrant interdiction
- Marine environmental protection
- Ice operations
- Other law enforcement.

These missions are so important to the Coast Guard that they have created divisions specific to each mission. The USCG is constantly reorganizing but the most updated organizational chart of the divisions can be seen below:

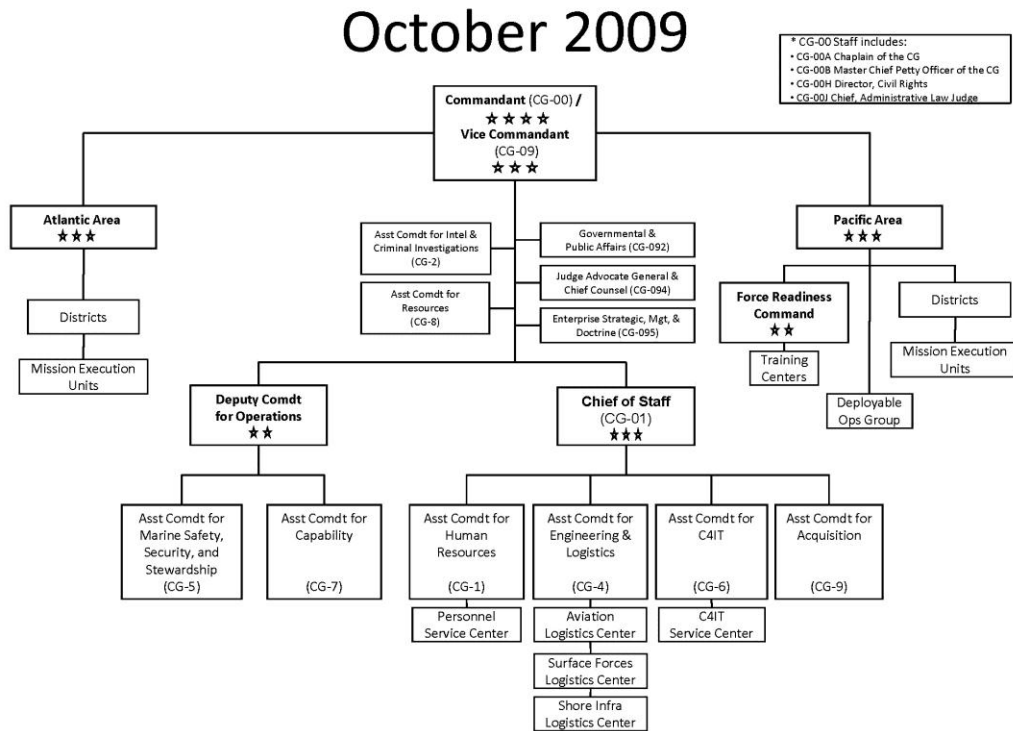


Figure 3: USCG Divisions Organizational Chart

By creating multiple divisions they are able to focus on each problem separately, which helps to simplify bureaucratic matters and improve results. Several of these eleven missions are extremely important to maintain marine safety, which is not only a large concern of the Coast Guard but the driving force of the project. These missions are marine safety and marine environmental protection. This project team worked specifically CG-5 divisions, Asst Comdt for Marine Safety, Security, and Stewardship.

2.1.3 Captain of the Port Zone (COTP zone)

The COTP zone is in charge of enforcing port safety and security and marine environmental protection regulations (Marine Exchange of Alaska, 1994). In order to enforce these regulations, the nine districts are broken up into 41 COTP zones (Patricia Adams, Personal Communication, November 7th, 2011). By breaking up the districts even further into these zones, the USCG is able to better enforce the multitude of regulations it has set forth and to maintain safety for everyone in the area.

2.1.4 Law and Policies for Emergency Towing Services

All companies owning response vessels are required to follow specified laws and regulations set down by the U.S. Coast Guard and its division (Niles, 2010). These laws relate to all of the following categories:

- Credentials
- Documents and records
- Navigation safety equipment
- Lifesaving equipment
- Towline and terminal gear equipment
- Pollution prevention equipment
- Firefighting and prevention equipment
- Hazardous condition of vessel
-

The USCG compiles all of their regulations into the Code of Federal Regulations (CFR). The CFR is split into many sections depending on the branch of the government and what the regulations are mandating. The USCG is responsible for the following sections of the CFR, among others:

- Shipping
- Navigation and Navigable Waters
- Transportation

Most regulations regarding emergency towing can be found in the shipping section of the CFR. This section is written and revised by the VRP division (See Appendix B for Salvage and Marine Firefighting Regulations).

2.2 Oil and Pollution Act of 1990 (OPA 90)

In March of 1989, the oil tanker Exxon-Valdez struck a reef in Prince William Sound, Alaska (EPA, 2011). A photo of the tanker can be seen below in Figure 4.



Figure 4: Exxon-Valdez Oil Tanker Leaking Oil

Over 11 million gallons of oil spilt into the surrounding waters, the largest oil spill in the United States at the time. The nation was unprepared to deal with a crisis of this nature, and the cleanup efforts proved time consuming. “The spill posed threats to the delicate food chain that supports Prince William Sound’s commercial fishing industry. Also in danger were ten million migratory shore birds and waterfowl, hundreds of sea otters, dozens of other species, such as harbor porpoises and sea lions, and several varieties of whales” (par 2). To see all the areas affected from the oil spilt from the Exxon-Valdez refer to the map below in Figure 5.



Figure 5: Areas Affected by Exxon-Valdez Oil Spill

Easily seen in the map, slow response times allowed the tanker to leak an increased amount of oil into the water. There was no recovery effort for three days and the oil was allowed to extend 470 miles to the southwest. Unfortunately, there are still remnants of pollution in many of these areas today. From this disaster, it became clear the United States had to be better prepared for possible oil pollution.

In August of 1990, Congress passed the Oil Pollution Act (OPA). The main goal of this act was to prevent pollution and ensure more efficient clean up, as it states: "A company cannot ship oil into the United States until it presents a plan to prevent spills that may occur. It must also have a detailed containment and cleanup plan in case of an oil spill emergency" (Donjon-SMIT LLC, 2011d, par 2). It required the Coast Guard improve regulations that were at the time applied to oil tank vessels and the owners. For example, it improved the standards of which the hulls were expected to be at, providing better protection from possible spills and pollution.

The OPA 90 not only mandated the use of double hulled tankers and Vessel Response Plans, but also allotted money for the nation to use in the case of oil pollution (Donjon-SMIT LLC, 2011d). This act is the basis for many of the regulations put in place by the Coast Guard today. The OPA 90 regulations have most currently been updated in February of 2011 and will continue to ensure the safety of the United States waters.

2.3 Vessel Classification Societies (Class Societies)

“Class Societies” have been in existence since the second half of the 18th century when those investing money in shipping decided they needed a way to determine the quality of the ships they were putting money into (IACS, 2011b). The first class society, Lloyd’s Register, was

founded in London in 1760. Lloyd’s Register would publish a registry of ships every year to evaluate the risk of insuring said ships. The ships in this registry were submitted to Lloyd’s Register for review. Once reviewed and classified, they were considered to be the most creditable vessels. Lloyd’s Register is still in business today, but a lot has changed (Lloyd’s Register, 2011). Class societies are still important today because they keep the commerce side of maritime industry running (CDR James Rocco, personal communication, November 1, 2011).

“The purpose of a Classification Society is to provide classification and statutory services and assistance to the maritime industry and regulatory bodies as regards maritime safety and pollution prevention, based on the accumulation of maritime knowledge and technology” (IACS, 2011a). Class societies work alongside the Coast Guard to maintain the safety of ships and to ensure the seas are clean (IACS, 2011b). A main responsibility of the class societies is to conduct surveys in order to assess the safety of the vessels. These surveys are equivalent to Coast Guard inspections and save the Coast Guard time and effort (CDR James Rocco, personal communication, November 1, 2011). “A classification survey is a visual examination that normally consists of:

- An overall examination of the items identified in the rules for survey
- Detailed checks of selected parts, on a sampling basis
- Witnessing tests, measurements and trials where applicable (IACS, 2011a)”

The surveyor looks for structural defects or other limiting factors that may render the vessel unsafe. All reported information is taken into account, including repair recommendations, and its class is assigned. It is during the surveys where the class societies also determine if vessels meet the proper requirements for specific certificates, such as Load Line Certificates as discussed later in the chapter.

2.3.1 International Association of Classification Societies (IACS)

The IACS, founded in September of 1968, is made up of the most prestigious class societies with the IACS Headquarters based in London (IACS, 2011b). Out of all the class societies around the world, thirteen make up the IACS. These important societies are shown in Table 1 below:

Table 1: IACS Members			
Name	Abbreviation	Founding Date	Head Office
Lloyd's Register of Shipping	LR	1760	London
Bureau Veritas	BV	1828	Paris
Registro Italiana Navale	RINA	1861	Genoa
American Bureau of Shipping	ABS	1862	Houston
Det Norske Veritas	DNV	1864	Oslo
Germanischer Lloyd	GL	1867	Hamburg

Nippon Kaiji Kyokai	NKK	1899	Tokyo
Russian Maritime Register of Shipping	RS	1913	Saint Petersburg
Polish Register of Shipping	PRS	1936	Gdansk
Croatian Register of Shipping	CRS	1949	Split
China Classification Society	CCS	1956	Beijing
Korean Register of Shipping	KR	1960	Daejeon

Together these societies have set compliance rules and standards that cover more than 90% of the world’s cargo carrying tonnage. (IACS, 2011b)

The IACS works closely with the International Maritime Organization (IMO) in order to develop interpretations of the regulations the IMO implements (IACS, 2011b). The IMO is an organization which regulates international law on vessels and maritime activities. It is important to have a unified system so each of the IACS member societies is looking for the same specifications when certifying compliance.

2.4 Emergency Towing Services

Salvage and Marine Firefighting (SMFF) companies and their emergency towing services strive to protect the environment, citizens and distressed vessels. While these SMFF companies contract with multiple sub-companies that deal in day to day towing efforts, these bigger entities coordinate emergency salvage and marine firefighting jobs. All along the coastal waterways and almost every coastal country, these companies, will at any time be available to respond to any emergency which falls within their areas of expertise.

2.4.1 Major Emergency Response Companies, “The Big Four”

In the United States, there are thousands upon thousands of miles of coast line that ships travel along each and every day; and unfortunately, accidents occur that require the help of an emergency towing service (U.S. Coast Guard, 2011e). There are four major companies in the U.S. that stepped forward to create a network of emergency marine services, in order to meet the updated Oil Pollution Act of 1990 (OPA 90) regulations set by the USCG. These four companies which provide emergency response services are: Donjon-SMIT LLC, Marine Response Alliance, Resolve Marine Group, and T&T Bisso Response LLC. Donjon-SMIT is known for its unique real time location abilities. This company created a program which tracks the tugs it contracts with and updates all data in real time. Marine Response Alliance is a combination of five companies working in unison. Resolve Marine Group currently has a “one call” system in place, used to minimize the effects of marine pollution. T&T Bisso is capable of responding to not only to marine emergencies, but also land based incidents. (See Appendix C for more details on each company)

2.5 Salvage and Marine Firefighting (SMFF) Vessels and Characteristics

When an emergency situation occurs, salvage and marine firefighting (SMFF) vessels are sent out to respond. Salvage can refer to towing a ship that is stranded, refloating one that has sunk, or patching up a damaged ship. This is important because a sunken ship can still leak oil into the environment, as does a stranded or damaged ship.

2.5.1 General Types of Salvage

Salvage can be broken down into five major categories: offshore, harbor, cargo and equipment, clearance, and afloat (Bartholomew, 2008). Offshore salvage is when the vessel in need of assistance has sunk or become stranded in exposed waters. It is the exposed waters that make this type of salvage difficult. The currents and waves are unpredictable and the weather can be challenging. Harbor salvage takes place in sheltered waters. These situations are still urgent, but they are not as time dependent as offshore salvages, because the weather and water conditions do not normally damage the boat as fast as open waters do. Cargo and equipment salvage is specifically getting the cargo on board a ship off before the vessel sinks. For example, if a ship is carrying materials that pose a threat to the environment, it would be urgent to get the hazardous materials off the vessel before attempting to tow it to shore, as the material may leak into the water as the ship is being towed.

Clearance salvage most commonly takes place after severe weather conditions (Bartholomew, 2008). It refers to the salvage of multiple vessels at one time. For example, if a hurricane hit a marine port and damaged multiple ships that were not properly docked, then it would require multiple salvors to remove the boats. Lastly, afloat salvage refers to when a vessel is still floating but is damaged and not able to make it to shore on its own. Depending on the amount of the damage, the ship would either have to be towed or it could be repaired out on the water. The most common distress situations only require emergency towing, and as a result, tugboats are the primary response units.

2.5.2 Unique Methods of Salvage

There are many specialized methods used by some of the SMFF companies. Pullers are hydraulic machines that can retrieve stranded vessels, whether they are on a beach, underwater, or upside down (Titan Salvage, 2011c). With up to a 300 metric-ton capacity these machines play a very important role in wreckage removal and emergency towing.

When attempting to retrieve a sunken ship, etc, out on the open ocean or in rough conditions, a jack-up barge can be built to ensure a safe and dry working environment (Titan Salvage, 2011c). These barges have cranes on top and specialized equipment to deal with any damaged vessels that most jobs utilize in order to repair the damaged vessel. The models of barges owned within the company range from 170 to 196 feet in length.

2.5.3 Characteristics of Response Vessels

Companies use tugboats to respond to marine distress situations (Marine Response Alliance, 2011b). Due to their great maneuverability and extreme pulling capabilities, salvage tugboats are equipped with extra cranes, steel to patch the hull of a ship, materials to weld with, and diving equipment: items not normally found on board other tugboats. However, which specific tugboat the salvage companies dispatch depends directly on the type of vessel that is

stranded and in need of assistance, the situation in which it is stranded, and the tugboats characteristics, (bollard pull, length, etc.).

Varying the characteristics such as bollard pull, length, etc. of response vessels results in vessels with very different capabilities and purposes. Figure 6 below is a typical harbor tug, while Figure 7 is an ocean going tug.



Figure 6: Typical Harbor Tug



Figure 7: Typical Ocean Tug

Situations these tugs would respond to are extremely different. The ocean going tug needs to be able to endure larger swells and stronger winds. For that reason it is 23.4 feet longer than the harbor tug and has larger dimensions including beam, draft, and freeboard. The ocean going tug also has a horsepower of 4400 while the harbor tug has a horsepower of 3800. These specifications are what set the two tugs apart.

Bollard Pull

Companies use bollard pull to determine which response vessel would be best to dispatch. It is considered the most important specification for emergency towing vessels (MSB Group, 2011). Bollard pull is measured in tons and related to the horsepower of a tugboat. It is commonly described as "the pulling capability of towing vessels" (HydroComp, 2007, para 1). The bollard pull necessary to tow a distressed vessel varies depending on vessel type, both tugboat and stranded ship, and weather conditions, as seen in Table 2.

Table 2: Bollard Pull Examples (Oil Spill Task Force, 2002, pg. 5)

EMERGENCY TOW VESSEL CAPABILITY MATRIX (BOLLARD PULL IN TONS)

<i>Study</i>	<i>Assisted Vessel Type/Size (deadweight tons)</i>	<i>Moderate Weather Seas 10-20', Winds 20-40 kts.</i>	<i>Very Rough Weather Seas > 20', Winds > 40 kts.</i>
Washington State Office of Marine Safety (Allan) Emergency Towing System Task Force Report, 1994 ¹	All Types up to 180,000 Tons	100	150
Canadian Council of Ministers of the Environment (Allan & Dickins) A Review of Escort, Rescue and Salvage towing Capability in Canadian Waters, 1995 ²	265,000 Ton Tanker	42 (South BC) – 70 (North BC) South BC = West Coast of Vancouver Island North BC = Queen Charlottes & North	120 (South BC) – 220 (North BC)
Alaska Department of Environmental Conservation Best Achievable Technology, 1997 ³	265,000 Ton Tanker	Not Addressed	90-125
Enhanced Puget Sound International Tug of Opportunity System (ITOS), 1998 ⁴	<u>Tanker/Bulker</u> <40,000 40, 000 – 75,000 75,000 – 125,000 125,000 – 250,000 <u>Container/Cruise/Car Carrier</u> <40,000 40,000 – 75,000 75,000 – 125,000 125,000 – 250, 000 <u>Reefer/RORO/Log</u> <40,000 40,000 – 75,000 <u>Fishing</u> <40,000	35-39 40-59 >60 >60 40-59 >60 >60 >60 35-39 40-59 35-39	40-59 >60 >60 >60 >60 >60 >60 40-59 >60 40-59
United Kingdom Emergency Towing System, 1998 ⁵	265,000 Ton Tanker	Not Addressed	125

¹ Worst Case Planning. Planning factor was the capability to effectively respond to 99% of vessels adrift in severe conditions (slightly less than Very Rough above).

² Worst Case Planning. Planning factor was the capability to effectively respond to 94% of vessels adrift in severe conditions (slightly less than Very Rough above).

³ Worst Case Planning. Planning factors based on tank vessel and tow vessel operator experience and actual towing tests.

⁴ All Case Planning. Planning factors based on tow vessel operator experience.

⁵ Worst Case Planning. Planning factors based on actual emergency towing experience.

From viewing the table, it is clear the deadweight in tons of the vessel, severity of the weather and the bollard pull are all directly correlated. For a tanker with a deadweight of less than 40,000 tons in moderate weather, a bollard pull between 35 and 39 tons will suffice. However, for a tanker with deadweight of 75,000 tons in rough weather, a bollard pull more than 60 tons is required to ensure a successful tow.

It is important to know to ensure a tug with the appropriate bollard pull is dispatched. If the bollard pull of a vessel is not known, there is no way to guarantee that the vessel being sent

out to an emergency will be able to help. If the wrong tugboat is sent to respond in the first attempt, then more time will pass while the correct vessel to dispatch is identified. Since the first tugboat is not able to do anything, not only is time and money wasted but major environmental damage can occur if the disabled vessel has hazardous cargo.

Offshore Capabilities

Emergency response vessels are separated into three service classes:

- Harbor; can travel 0 miles offshore
- Coastal; can travel 0-12 miles offshore
- Ocean; can travel 0-50 miles offshore

One way of determining vessels offshore capabilities is by examining the stability. This done by calculating the Metacentric height and right arm curve. However, this requires in-depth, time consuming equations that quickly become difficult. A faster way of identifying vessels offshore capabilities is by examining the vessels possession of a load line.

A load line marks the maximum allowable height the water can safely rise to on the side of the vessel, taking into consideration the time of year and type of water (Det Norske Veritas, 2011). This is typically done in steel lettering on the side of the vessel and the individual lines are measured down from a reference point typically immediately below the boat deck. Below is a picture depicting a load line that would typically be seen on a vessel.

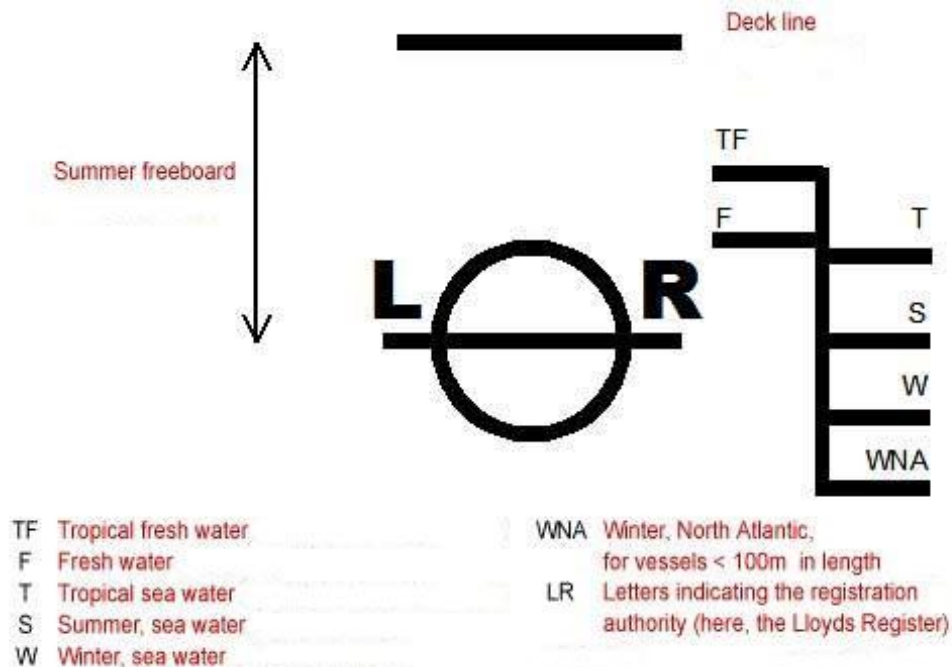


Figure 8: A Typical Load Line with Legend (Blogspot, 2011)

The circle in the center with the line running through it is referred to as a plimsoll mark. The L and the R represent the initials of the company (in this case Lloyd's Register) who is responsible for granting the load line certificate. A load line certificate indicates that a class society has surveyed the vessel and deemed it safe for offshore operations. After the survey the class society makes note of the correct corresponding heights of the water for specific seasons and indicates them in the certificate. In order for a vessel to be deserving of a load line, it must first meet two simple requirements (Tom Gruber, Personal Communication, 2011):

1. Have a length exceeding 79 ft
2. Travel more than 20 miles offshore

If both of those requirements are met, then a classification society performs a survey of the vessel, verifying "that the vessels' strength and stability have been approved for the draught corresponding to the freeboard mark given on the certificate and that the vessel at the maximum draught has a reserve buoyancy and bow height in compliance with the requirements of the ICLL" (para. 3). The main reason vessels are assigned load lines is to ensure the safety of the vessel and its crew (U.S. Coast Guard, 2011i). Load lines are meant as a verification symbol to ensure a vessel possesses a multitude of abilities including:

- A robust hull that can withstand severe sea conditions
- Weathertight & watertight integrity
- The vessel has reserve buoyancy and is not overloaded
- The vessel has adequate stability for all loading & operating conditions
- Rapid drainage of water on deck (boarding seas)
- Safety of crew while working on deck
- Modifications to vessel do not compromise seaworthiness
- Periodic inspections (afloat and drydocked) to verify that the above are properly maintained

Load lines are helpful when validating the offshore capabilities of the response vessels and verifying how far from shore a response vessel can successfully operate. It is important to remember not all ocean going tugs have load lines because they are not yet required.

Other Characteristics

Bollard pull and offshore capabilities are important to guarantee a vessel will be able to tow the disabled vessel and reach the location of the incident, but many other characteristics come into play in an emergency situation. Other characteristics of emergency response vessels most commonly provided are:

- Vessel name
- International Marine Organization (IMO) Number or Official Number
- Resource Provider
- Call Sign
- Length

- Hull Depth
- Hull Breadth
- Net Tonnage
- Horsepower
- Number of Propellers
- Towing Gear
- Firefighting Capabilities

This is important to have so tugs can easily be compared. An emergency response vessel with extensive towing gear would not be helpful in the case of a fire. It would have to be easy to access information on the response vessels firefighting capabilities instead.

2.6 Emergency Towing Situations

Whether working or enjoying free time people in boats and ships can get into emergency situations on the open water at any given moment without warning. When this does happen, response vessels are dispatched from various salvage/marine firefighting companies to assist. However, several factors come into play when attempting to send out an emergency vessel. One of the most important factors is that there are a limited number of tugboats in every port, and their capabilities greatly vary. The problem with the variety of tugboat's capabilities is that most are not designed to travel more than twelve miles out to sea to perform emergency towing operations. Many vessels' offshore abilities are limited by a number of factors, ranging from not having enough fuel, to not being able to handle the swells of the open ocean.

Another issue is that the tugs are independently owned and their companies contract to multiple SMFF providers; because there is no limit on how many contracts these tugboat companies can make, many times the same tugboats are listed by several companies, salvage or not. As a result, the main problem with the multiple contracts between SMFF companies and other companies is that more often than not the tugs will become double booked. A classic example would be that a ship is in duress and calls the SMFF companies to be rescued. Once the SMFF companies have all the pertinent information on the distressed vessel it contacts all the tugboats nearest to the location of the distressed vessel and sends the necessary amount of available tugboats needed to complete the operation. However, it is not uncommon for many of tugboats in the surrounding area to be busy with daily tasks such as pulling barges up and down the coast, or docking a ship. The double booking of these tugboats causes for many distressed ships to be stranded for a potentially dangerous amount of time.

Since it is more lucrative for the tug to complete the everyday task of docking a ship, or towing a barge, it will first finish the task at hand, then go rescue the ship in need (Patricia Adams, Personal Communication, September 27, 2011). This causes many problems because while the tug is finishing up its current job, many things could happen to the ship in need. One example would be that by the time the tug gets out there, the disabled ship could have run into another ship, or an oil rig. The small incident of a disabled ship then turns into a very large disaster. All of these aforementioned issues add up and create a very large problem for the Coast Guard, who is currently trying to optimize response times to emergency situations.

2.6.1 Possible Distress Situations

There are many possible situations that would result in the need for a response vessel to be dispatched (Mesriani Law Group, 2007). If there is a mechanical failure in a vessel, it could prevent it from being able to start its engine and reach the shore. Also, it is not uncommon for a boat to unknowingly run aground. Both of these situations would require a tugboat to tow the stranded ship to shore. A mechanical problem could also lead to a fire aboard the ship. In this case a response vessel with firefighting capabilities would be needed to put the fire out.

At times, the weather out on the water can become so severe so quickly that a ship does not have time to react (Boat Safe, 2009). Strong winds or heavy rain can make it hard to navigate, which can lead to a collision, be it with another vessel or a submerged object. It is also possible for lightning strikes to damage equipment on a vessel. The job itself of responding to a disabled vessel is also complicated during severe weather. The responding vessel has to be able to operate in the wind and swells, both of which exacerbate the ability to hook up the disabled vessel to the tug and increase the bollard pull needed to complete the tow.

2.7 Existing Salvage and Marine Firefighting (SMFF) Methods

In order to receive emergency help on the open ocean or along the coastlines, the vessel operator must have contracted with a towing company (Titan Salvage, 2011c). By telling the emergency response company the size and usual cargo of the vessel, the company will be able to dispatch an emergency towing/wreckage removal squad in the event of failure. It is important that this information be recorded in the contract precisely so the emergency towing company will be able to dispatch the correct type of emergency vessel, because each situation is unique and will require a specific response vessel.

2.7.1 Contracting and Dispatch

Most towing companies are equipped with the necessary resources to make a timely response. However, confusion can occur when dealing with an emergency, and so mistakes have been made. If the information about the vessel in need is not recorded correctly, the wrong response vessel can be sent out, wasting precious time. This is especially the case if the stranded vessel is offshore (over twelve miles out to sea), and it takes a long time to reach it. A call being placed to a towing company can be acted upon as quickly as a just a few minutes (Titan Salvage, 2011c). Some emergency response calls are a lot more serious than others. If a boat has crew members who are injured or stranded, then appropriate measures within the U.S. Coast Guard are additionally taken in order to ensure the safety of everyone.

Based on the information the company has been given about the distressed vessel, the type of ship responding and its abilities will vary in accordance with the type of accident (Titan Salvage, 2011c). Tugs make up the majority of vessels that aid in removal and in the transport of all other equipment that will be used to retrieve or aid the retrieval in an environmentally friendly and efficient way. All tankers are required to be contacted with a tugboat preapproved to respond in case of an emergency. Once a situation occurs, the vessel master notifies the Vessel Owner. It is the Vessel Owners' responsibility to contact the contracted towing company to dispatch an appropriate tugboat. While this transpires, the Coast Guard is responsible for overseeing the process and ensuring safety. More specifically, the Captain of the Port (COTP) is directly involved and must verify an adequate response vessel is being dispatched.

2.8 Regulations for Emergency Response Vessels

Every emergency response vessel used by marine salvage companies must be well documented and meet certain specifications in order to be classified correctly (U.S. Coast Guard and Vessel Inspection, 2004). This ensures effective use of time when choosing the correct vessel to dispatch. It also guarantees that the vessel sent out will be able to productively assist the disabled vessel.

2.8.1 Required Gear

Response vessels must meet specifications not required of commercial or privately owned vessels (Response Boat Project, 2011). This is because they must always be ready to respond to any type of emergency situation, be it a fire, vessel run aground, or just possibly someone who has taken ill on board the ship. Below is an example of items a response vessel is required to possess on board not found on other ships:

[Orig] Construction Standards (Response Boat Project, 2011, para 4)

- A-4 FIRE FIGHTING EQUIPMENT
- A-6 REFRIGERATION AND AIR CONDITIONING EQUIPMENT
- A-16 ELECTRIC NAVIGATION LIGHTS
- A-20 BATTERY CHARGING DEVICES
- A-23 SOUND SIGNAL APPLIANCES
- A-24 CARBON MONOXIDE DETECTION SYSTEMS
- A-25 POWER INVERTERS
- A-27 ALTERNATING CURRENT (AC) GENERATOR SETS
- E-2 CATHODIC PROTECTION
- E-4 LIGHTNING PROTECTION
- E-10 STORAGE BATTERIES
- E-11 AC & DC ELECTRICAL SYSTEMS ON BOATS
- H-1 FIELD OF VISION FROM THE HELM POSITION
- H-4 COCKPITS AND SCUPPERS
- H-13 GLAZING MATERIALS
- H-22 ELECTRIC BILGE PUMP SYSTEMS
- H-27 SEACOCKS, THRU-HULL CONNECTIONS, AND DRAIN PLUGS
- H-30 HYDRAULIC SYSTEMS
- H-31 SEAT STRUCTURES
- H-32 VENTILATION OF BOATS USING DIESEL FUEL
- H-33 DIESEL FUEL SYSTEMS
- H-40 ANCHORING, MOORING, AND LIFTING
- H-41 REBOARDING MEANS, LADDERS, HANDHOLDS, RAILS AND LIFELINES
- P-1 INSTALLATION OF EXHAUST SYSTEMS FOR PROPULSION AND AUXILIARY ENGINES
- P-4 MARINE INBOARD ENGINES AND TRANSMISSIONS

- P-24 ELECTRIC/ELECTRONIC PROPULSION CONTROL SYSTEMS
- T-5 SAFETY SIGNS AND LABELS
- T-17 COMPASS INSTALLATION
- TA-27 BATTERIES AND BATTERY CHARGERS
- TH-23 DESIGN, CONSTRUCTION, AND TESTING OF BOATS IN CONSIDERATION OF CARBON MONOXIDE
- TY-28 BOAT LIFTING AND STORAGE

While some of the items on list like seat structures (H-31 in list) are found in all vessels, it is extremely important that emergency response vessels have all of this equipment. The response gear is what makes them able to respond to emergencies and assist on scene (Response Boat Project, 2011). The gear found on this list is also held to a different standard than that required of privately owned vessels. For example, all vessels carry some type of firefighting equipment, like a small fire extinguisher. However, the firefighting gear required in this list (A-4 in list) must have capabilities of being able to assist other vessels in duress on a much larger scale. An example of the firefighting gear found on response vessels can be seen in operation in the figure below.



Figure 9: Firefighting Gear in Action

Only tugboats that respond to emergency situations are required to have this gear, separating them from other vessels. If they did not carry all of this material, the vessels would just be any other ship out on the ocean and would be of no use in an emergency situation.

2.8.2 Appropriate Sized Towing Vessel

The Coast Guard has instituted many regulations to avoid potential disasters, including one that mandates every emergency response vessel new to a port must be registered according to the vessel's size, tonnage, and cargo along with other details (U.S. Coast Guard and Vessel Inspection, 2004). Once a marine vessel does this, appropriate calculations can be carried out to determine what the bollard pull of the vessel would be. Using that information, when an emergency occurs the salvage company will quickly be able determine if a specific emergency towing vessel is correctly sized for the job at hand. If a towing vessel is too small, it won't be able to complete the evolution safely and successfully.

2.8.3 Ability to Operate in Severe Weather

Another very important regulation is that the emergency vessels must be able to operate in bad weather conditions just as well as if the weather were good (United States Coast Guard, 2011f). To ensure this problem is addressed, all towing vessels must be rated in conditions that include up to 40 knot winds. In conditions of 40 knot winds, the sea becomes very difficult to operate on as swells become very large and boats are tossed around easily. The winds affect the size of the swells, making it more difficult to properly hook up and tow a stranded vessel. But this is the most crucial time for an emergency vessel to work because when conditions are bad, more accidents are likely to happen.

2.8.4 Time Requirements

For almost all marine response calls made by distressed vessels, the response time of the emergency salvage and marine firefighting vessels is crucial. In order to ensure these situations are dealt with in timely manner, U.S. Coast Guard has imposed a regulation stating the maximum amount of time is should take for emergency response vessels to certain situations (Department of Homeland Security, 2008). In Table 3 below, it can be seen that different situations are permitted various quantities of time to reach the disabled vessel and remediate the situation. Each service of salvage has an expected timeframe for completion in regards to near shore and offshore operations. Emergency towing vessels response plans are allotted up to 12 hours to respond to the distressed vessels near shore, while offshore plans are allotted up to 18 hours.

Table 3: Emergency Response Timeframe Regulations (Department of Homeland Security, 2008, pg 35)
TABLE 155.4030(b)—SALVAGE AND MARINE FIREFIGHTING SERVICES AND RESPONSE TIMEFRAMES

Service		Location of incident response activity timeframe	
(1) Salvage		CONUS: nearshore area; inland waters; Great Lakes; and OCONUS: < or = 12 miles from COTP city (hours)	CONUS: offshore area; and OCONUS: < or = 50 miles from COTP city (hours)
(i) Assessment & Survey:			
(A) Remote assessment and consultation		1	1
(B) Begin assessment of structural stability		3	3
(C) On-site salvage assessment		6	12
(D) Assessment of structural stability		12	18
(E) Hull and bottom survey		12	18
(ii) Stabilization:			
(A) Emergency towing		12	18
(B) Salvage plan		16	22
(C) External emergency transfer operations		18	24
(D) Emergency lightering		18	24
(E) Other refloating methods		18	24
(F) Making temporary repairs		18	24
(G) Diving services support		18	24
(iii) Specialized Salvage Operations:			
(A) Special salvage operations plan		18	24
(B) Subsurface product removal		72	84
(C) Heavy lift ¹		Estimated	Estimated
(2) Marine firefighting		At pier (hours)	CONUS: Nearshore area; inland waters; Great Lakes; and OCONUS: < or = 12 miles from COTP city (hours)
(i) Assessment & Planning:			*COM041*CONUS: Offshore area; and OCONUS: < or = 50 miles from COTP city (hours)
(A) Remote assessment and consultation		1	1
(B) On-site fire assessment		2	12
(ii) Fire Suppression:			
(A) External firefighting teams		4	12
(B) External vessel firefighting systems		4	18

¹ Heavy lift services are not required to have definite hours for a response time. The planholder must still contract for heavy lift services, provide a description of the heavy lift response and an estimated response time when these services are required, however, none of the timeframes listed in the table in § 155.4030(b) will apply to these services.

2.8.5 “Proper Characteristics”

Finally, as defined in the regulation, the responding emergency towing vessel must have the “adequate bollard pull, horsepower, and proper characteristics” in order to complete the task as assigned (See Appendix B for the entire regulation). The “proper characteristics” are currently undefined by the regulation, and it is left up to the vessels owner which characteristics to include. Many tug companies provide further information in towing vessel specification sheets available on their websites, but these are not presented in a standardized format and they do not all contain consistent types of information. It is time consuming to pull them up and find all the information needed, and as such, it requires the COTP and the salvors to respond to the situation by using their knowledge of towing situations and years of expertise to handle it carefully and professionally.

2.9 Regulations for Private/Commercial Vessels

The USCG (2011) also has many regulations put in place on tank vessels which may become distressed. One of these regulations is that every tank vessel must register with a SMFF response provider in each of the COTP zones that they enter. By requiring each tanker to register with a salvage company the response time between the distress call and the towing vessel

responding is cut down significantly (United States Coast Guard, 2011f). This is because less time is spent attempting to find a response vessel with the appropriate characteristics.

When registering, the new tanker must contact a salvage company and construct a Vessel Response Plan (VRP) to inform them of all of the specifications of their vessel. It is then the resource provider's job to ensure that a suitable tugboat is designated to respond. This is very important because if this information is not relayed correctly, the wrong response vessel could be sent out, and it would not be able to do anything to help.

2.9.1 Vessel Response Plan (VRP)

All the required specifications and necessary information can be found in the Vessel Response Plan (VRP) that every tanker is required to create. (United States Coast Guard, 2011f). Specifications include:

- Emergency Contact Number
- Tanker Dimensions
- Cargo
- Tonnage
- Crew
- Towing hook-up location and method
- Other (dependent on specific tankers)

A VRP is created by the owner of the tanker but has to be approved by the Coast Guard. If the tanker is from a foreign land, it must have a VRP registered with the Coast Guard of their respective country. If one is not available, they must create one while in U.S. waters in order to ensure the safety of everyone on the tanker and the port in which they are docked. By having all of this information in one packet, registering at ports is much more efficient. A VRP must also contain phone numbers of companies that should be contacted in case of an emergency situation. If a ship stays in one port, then it is only necessary to provide one number; however, if a tanker plans on traveling down the coast, phone numbers must be provided for each geographical region.

2.10 Other Nations

Most countries have a Coast Guard division equivalent within their government. Some examples are Her Majesty's Coast Guard (HMCG) for England, Qatari Coast Guard for Qatar, etc. These units are made of divisions (House of Commons; Transport Committee, 2011). Many foreign coast guards collaborate with the U.S. Coast Guard to resolve incidents in international waters involving Search and Rescue (SAR) and Fire and Rescue Services (FRS) missions, or international catastrophes such as oil/chemical spills and natural disasters. A current example of emergency salvage in another country would be the incident pertaining to the container ship *Rena* off the coast of New Zealand, which ran aground and is now leaking oil (BBC News, 2011). The ship has been labeled a "hazardous ship" and as such the salvage operation can be taken over by Maritime New Zealand at any time in order to ensure it is dealt with the correct way. Another example situation is the *MV Miner* running aground in Canada (The Canadian Press, 2011). The ship was being towed to be scrapped when it broke loose from the tug pulling

it and ran into the shore. The Canadian Coast Guard has been closely overseeing the Dutch salvage company's cleanup of this situation, and is looking into how the ship broke free from its tether.

2.11 Summary

Due to rough seas and a myriad of other factors, accidents and emergency situations arise. With the responses of both the United States Coast Guard (USCG) and Salvage and Marine Fire Fighting Companies (SMFC) these accidents can be dealt with effectively to ensure environmental and human safety as well as cost efficiency. The USCG lays down strict guidelines denoting which ships are allowed to do what and where. To ensure safety and an equitable market amongst all competing towing companies, these regulations are rigorously enforced. The major gap in the system is the varying methods of cataloguing available tugboats which can respond to an emergency towing situation. These varying methods do not presently provide sufficient information for the tugboat so the companies are not able to quickly make an informed decision. This can result in the dispatching of an inappropriate tugboat, which exacerbates the emergency situation. With an understanding of this gap in the current system, a helpful tool will be devised to improve upon and expedite the current way of dispatching emergency vessels.

3. Project Goals and Deliverables

The goal of this project is to develop an automated decision making tool for the USCG and the COTP by identifying characteristics that define tugboats as adequate when being chosen to rescue a distressed vessel. This tool will help improve the choosing of appropriate vessels in emergency marine situations as well as improve the response time of emergency towing situations. To fully assess the problem and to accomplish the goal, the following three objectives have been created to guide the process of collecting data:

1. Besides horsepower and bollard pull, determine which specifications, referred to as “proper characteristics” in regulation 33 CFR 155.4030e (See Appendix B), a towing vessel must have to be seen as an adequate response vessel.
2. Identify any gaps in the current system of cataloguing towing vessels, in San Francisco, that cause response time issues and need to be filled.
3. Using San Francisco Bay as a sample population, create a prototype tool to aid in the selection of appropriate tugboat(s).

The final deliverables will include the final report, containing all data collected and recommendations on those findings. Along with the final report, the developed prototype tool and an appropriate user guide (See Appendix D for complete user guide) will also be left with the USCG for further extension to all USCG areas. The prototype contains all the tugboats registered in the port of San Francisco and sorts them in a color coded fashion according to specific emergency situations. The user guide ensures easy use with step by step instructions along with definitions of needed inputs.

4. Methodology

The goal of this project is to develop an automated decision making tool for the USCG and the COTP by identifying characteristics that define tugboats as adequate when being chosen to rescue a distressed vessel. Through mainly data collection and informal discussions with individuals of the Coast Guard and salvage industry, an understanding of the current marine towing methods was obtained. The major topics of the research conducted included: Coast Guard regulations, towing vessel characteristics, understanding of marine engineering, and database software. By actively engaging all parties of emergency towing, it was aimed to create a tool that satisfies the needs and concerns of all involved.

4.1 Understand Current Methods of Emergency Response

To understand current methods of response, background research and interviews were conducted. Background research on USCG regulations was needed to understand how the industry expanded to where it is today. Interviews with current USCG employees were conducted to understand why the regulations are important and what role they play in emergency situation response. Interviews were also conducted with salvage and marine firefighting professionals in order to better understand how specific companies currently classify their tugboats and response to emergency situations. See Appendix E for Interview Summaries.

4.2 Understand Characteristics within Emergency Response Regulation

In order to understand which characteristics of tugboats best define them as adequate for emergency towing situations, in regards to the regulation 33 CFR 155.4030e (See Appendix B), research on tugboat specifications was conducted, along with several interviews.

To determine characteristics specific to the pulling force of tugboats, interviews and archival research were carried out. The interviews were conducted with Lieutenants working in the Marine Safety Center division of the USCG to specifically understand bollard pull and other required towing characteristics. Archival research of past e-mails between a Coast Guard Vessel Response Plan (VRP) program member and an employee of Seacoast Maritime Services was done to obtain equations of the bollard pull necessary to tow a specific vessel. From these equations, the characteristics essential to calculating the pulling force of a tugboat were deduced.

Background research on load lines and classification societies was also needed along with several interviews in order to determine necessary offshore characteristics. The research was completed on the International Association of Classification Societies (IACS) and American Bureau of Shipping (ABS) official websites. The interviews were conducted with the USCG Class Society Liaison and two current ABS employees.

Lastly, data collection and interviews were completed to conclude which characteristics are necessary to successfully complete a towing evolution according to an array of weather conditions. The data was gathered from the Navy Towing Manual and the interview was with a Navy Towing and Salvage Engineer, who is also the Supervisor of Salvage and Diving.

4.3 Identify Current Port and Determine Needed Improvements

In order to identify where improvement is needed in response time issues in the current system of cataloguing towing vessels, a specific port needed to be chosen to be a representative sample. A port was chosen by researching ports with a diverse tugboat sample and what ports are currently working on projects similar to the one described in this report.

Methods of background research, data collection, and interviews were executed to gain a better understanding of how the emergency towing industry currently operates. The significant characteristics discovered through the first objective were also utilized. Through research of the core Geographic Specific Appendices (GSAs), a list of all the tugs currently registered in the chosen port was compiled. Data collected from the following resources was then used to provide the information needed in the list for the characteristics (discovered in objective 1):

- The Marine Information for Safety and Law Enforcement (MISLE)
- The American Bureau of Shipping (ABS)
- Tugboatinformation.com
- Coast Guard Business Intelligence (CGBI)- Cube Report

Data was also gathered from the following companies:

- K-Sea Transportation
- Foss Maritime
- Oscar Niemeth Towing
- Westar Marine Services
- Sause Bros INC
- Baydelta Maritime
- Dunlap Towing
- Harley Marine

Interviews with employees of multiple salvage and towing companies including Donjon-SMIT, Resolve Marine Alliance, and Harley Marine Services were held to assess where improvement is needed from the industries point of view, including: inconsistencies among the Coast Guard and salvage companies and the lack of information available on towing vessels. Interviews with two members of the Harbor Safety Committee, based in the port of San Francisco, provided the last of the information needed to determine where improvements are needed in the cataloguing of the tugs in the port.

4.4 Database Construction

To make improvements where needed an automated prototype database was created. First background research was conducted on several programs and their criteria. After a program was chosen, it was necessary to watch tutorials and meet multiple times with an MST1 Coast Guardsman to learn how to develop the prototype. Once created, a testing plan was developed to ensure maximum efficiency. The results from the testing plan were used to correct errors and improve use of the prototype.

5. Results and Analysis

In achieving the goal of this work, it was first necessary to understand the context in which the distressed vessel and emergency response tugs may find themselves, as well as the characteristics of each vessel. Initial research indicated that relevant parameters for the tug may include towing capability (bollard pull), freeboard, and stability in open or coastal waters. For the distressed vessel, important characteristics may include ship dimensions, weather conditions, and wind resistance. The following sections discuss these aspects in detail.

5.1 Current System Operation

The background chapter of this report includes all research previously conducted to understand the Coast Guard regulation referring to emergency response. When a vessel encounters an emergency situation, the vessel master notifies a Qualified Individual. This individual assumes the shorebased aspects of managing the incident response on behalf of the vessel owner/operator and master and contacts their contracted providers. Depending on the magnitude of the incident and response, the spill management team may include representatives from the vessel owner/operator (responsible party), private response contractors (for oil recovery, salvage and marine firefighting), state and local governments, and the Federal On Scene Coordinator (the Coast Guard for marine spills). Both the shipowner and Coast Guard have access to list of towing vessels available under contract with the distressed vessel's salvage provider. The salvage contractor's towing vessel lists may contain over a thousand subcontracted towing vessels of various sizes and configurations. There are essentially no privately owned and operated towing vessels dedicated to emergency towing in the United States. This means that the spill management team must find a commercial towing vessel that is both adequate and immediately available to assist the distressed vessel. Since the towing vessels are not dedicated emergency response vessels, it is very likely that they will be contracted to work another non-emergency related towing job and will have to break that commitment in order to respond to the emergency. The towing vessels are also under contract with the primary salvage response providers, creating a complicated situation that can negatively affect an efficient emergency response as the spill management team searches for the most expeditious solution. Finding adequate towing vessels for the distressed vessel involves working with the contracts stated above and communications with the parties mentioned, these constraints result in delays to emergency response.

Further delaying response times, emergency response providers are only required to list emergency response vessels with adequate bollard pull, horsepower, "proper characteristics," and the ability to operate in forty knot winds within the VRP of a vessel. They are not required to list the information about the response vessels, and it is difficult to match an emergency response vessel to a specific situation with only this information. Salvage companies do provide more detailed information about their tugs on their websites, but this information is not consistent among all salvage companies.

5.2 Selection of Geographic Area for Prototype

In order to incorporate real data into the decision making tool, tugs currently located in San Francisco Bay were chosen due to the port's size, tug diversity, and current involvement in a similar project. The Harbor Safety Committee (HSC), which is a group of port users and

interested parties who meet together to make recommendations to the USCG COTP and to each other in order to improve the safety of the port. The San Francisco HSC, which is very active, had already begun compiling a list of important characteristics on the tugboats within the area. Their research and insight greatly influenced the direction of the project. The characteristics the committee concluded to be significant contained:

Table 4: Tug Characteristics Used by San Francisco Harbor Safety Committee
Tug name
Breadth (ft)
BHP (HP)
LOA (ft)
Draft (ft)
Ocean Going (Y/N)
Bollard Pull Ahead (Short Tons)
Bollard Pull Astern (Short Tons)
Tow Retrieval Gear Y/N (Orville Hook)
Anchor (Y/N)
Bow Winch Gear
Fire Monitor (Y/N)
Fire Monitor Quantity
Total GPM Seawater
Total Gallons AFFF

Even though the San Francisco Harbor Safety Committee is working on re-classifying all the active tugboats in their area, the current method of dispatching emergency towing vessels has not incorporated the work done by the committee. All of these characteristics proved helpful in the determination of the characteristics used in the decision making tool.

Along with the extremely active HSC, San Francisco was also chosen because of its high volume of traffic and the large number of emergency response vessels active within it. Currently it has ninety-one tugboats which are listed as emergency response vessels.

5.3 Pertinent Characteristics of Tugs

Tugboat’s characteristics vary from small harbor tugboats to larger ocean-going vessels. These different specifications enable the vessels to complete their tasks. While attempting to define the characteristics of tugboats, which was needed to understand adequacy, two issues kept rising:

- Can the tug handle the sea conditions where the distressed vessel is located?
- Can the tug then tow that distressed vessel to a safe location?

Knowing if the tug can handle the sea conditions proved pertinent because many tugs have restrictions on the environment and distance offshore they can operate in. Many are not designed to handle the wind and waves found in the open ocean. Under current U.S. regulations in Title 46 of the Code of Federal Regulations, towing vessels are not inspected by the Coast Guard, and any data on the tug’s stability and capabilities are provided in a voluntary system.

While a full calculation of the vessels' stability in all sea conditions would be ideal to determine if the tug can handle the sea conditions where the distressed vessel is located, this was found to be impractical to implement given the sparse data. A simplified approach is both realistic and sufficient for the task at hand. This approach entailed examining services classes the companies sort their tugboats into, (see Table 5 below), and aspects of load lines.

Table 5: Tugboat Service Classes	
Distance from Shore (Nautical Miles)	Tugboat Service Classes (Ocean, Coastal, Harbor)
0	Harbor
0-12	Coastal
0-50	Ocean

As uninspected vessels, companies that own the tugs are responsible for knowing how far offshore the tugs can operate, and typically place them in one of the three categories above. Tugs can be assigned load lines that are proof that the vessel is able to travel and operate offshore. When a class society such as the American Bureau of Shipping (ABS) gives a vessel a load line, the vessel must meet the class societies' standards of certification (Tom Gruber, Personal Communication, November 7th, 2011). Unfortunately, since not all ocean-going tugboats are required to receive a load line, it is an important but not a deciding characteristic. As such, it was more efficient to rely on the three separate Tugboat Service Classes to determine offshore capabilities.

It is also essential that the tugboat selected will have the capabilities to tow the distressed vessel. The force needed to tow varies depending on the size of the distressed vessel and the current weather conditions. In order to determine if the tug can tow the disabled vessel efficiently, the following list of characteristics for the tugboat was compiled:

Table 6: Significant Tugboat Characteristics	
Characteristic	Unit
Bollard Pull	Short Tons
Brake Horse Power	HP

The information needed for the distressed vessel can be seen in the table below:

Table 7: Distressed Vessel Characteristics	
Characteristic	Unit
Length	ft
Breadth	ft
Draft	ft
Height	ft
Block Coefficient	N/A
Type of Vessel	Tanker, Cargo Ship, etc.

The information needed for weather conditions can be seen in the table below:

Table 8: Weather Conditions	
Variable	Unit
Wind Speed	Knots
Wind Drag Coefficient	N/A
Heading Relative to Wind	Degrees

With all of this information collected on the distressed vessel and its current weather conditions, the necessary bollard pull needed in order to move the distressed vessel can be calculated. These calculations have been incorporated into the decision making tool and will be explained further in the next section.

5.4 System development

The decision making tool was based off the most basic characteristics of the tugboats to ensure easy use. These included:

Table 9: Tugboat Characteristics in Database	
Characteristic	Unit
Official Number	N/A
International Marine Organization (IMO) Number	N/A
Company Name	N/A
Resource Provider	N/A
Length	ft
Breadth	ft
Draft	ft
Bollard Pull	Short Tons
Brake Horse Power	HP
Service	Harbor, Coastal, Ocean

As mentioned in the previous section, bollard pull, horsepower, and the service class of the tug are the most essential characteristics in determining if a tug is adequate. However, the other characteristics listed in Table 9 were found to also be important when choosing an appropriate tugboat. The dimensions can be used in the field as a quick reference to the tug's offshore capabilities, while the other information is important to help contact and identify the tug.

Using these characteristics, all tugboats are filtered and a well-suited tug can be ascertained in the following manner;

1. Tugs are filtered according to the distance in NM from shore the incident has taken place; only tugs that can travel the appropriate distance will be considered in the results.
2. The dimensions, block coefficient, and draft must be considered in order to calculate the displacement of the distressed vessel.

3. The displacement is used to calculate the necessary bollard pull required to move the distressed vessel.
4. The necessary bollard pull is combined with the resisting forces of drag, caused mainly by the wind acting on the vessel.
5. This bollard pull number is then compared with the bollard pull of the available tugs in the port, and in order for the tug to be able to pull the distressed vessel, it must have a bollard pull which is equivalent or greater than that of the necessary bollard pull which has just been calculated.

A detailed account of all the equations used in the database can be seen below in Table 10 for a more clear understanding.

Table 10: Equations Used In Database Tool	
Variable	Variable Equation
Displacement	$= \frac{LOA * Breadth * Draft * Block Coefficient}{35}$
Ideal Weather Bollard Pull	$= Displacement * \frac{60}{100000} + 40$
Frontal Area	$= (Height - Draft) * Breadth$
Wind Resistance	$= \frac{0.00560 * Frontal Area * Wind Drag Coefficient * Max Wind^2 * Heading Coefficient}{2205}$ <p style="text-align: center;">*Note: 2,205 = lbs to metric tons conversion</p>
Actual Bollard Pull	$= Ideal Weather Bollard Pull + Wind Resistance$

The block coefficient used in the displacement equation is a constant that varies depending on the type of vessel in distress (tanker, barge, etc.). The displacement equation was needed in order to determine the Ideal Weather Bollard Pull equation. The Ideal Weather Bollard Pull equation was used to determine which tugboats would be classified as yellow, and is used in the Actual Bollard Pull equation. Frontal Area was calculated to ensure an accurate Wind

Resistance was considered along with the Ideal Weather Bollard Pull to determine the Actual Bollard Pull. The Actual Bollard Pull takes current weather conditions into account and is used to classify tugboats as green.

For a user-friendly approach, all the calculations mentioned above were programmed to be done automatically within the prototype. Figure 10 below is a view of the Access Database Input form.

Distressed Vessel Situation Input

Vessel Clear Form Return

Distressed Vessel:

Classification:

Contracted SMFF: All SMFFs [?](#)

Distress Distance: NM [?](#)

Vessel Dimensions

Length Over All: m ft [?](#)

Breadth: m ft [?](#)

Draft: m ft [?](#)

Height: m ft [?](#)

Deadweight Tonnage: Metric tons Short tons [?](#)

Weather Conditions

Heading Relative to Wind: [?](#)

Beaufort Scale: [?](#)

Figure 10: Access Database Input Form

The user simply inputs the information in all the blank fields relating to the distressed vessel and then for the Heading Relative to Wind, Classification, Contracted SMFF, and Beaufort Scale they select the appropriate choice from the drop down tables. The choices for the drop down tables are as follows:

Table 11: Access Input Drop Down Tables				
Needed Field	Drop Down Table			
Classification	Tanker			
	Large Tanker			
	Very Large Crude Carrier (VLCC)			
Contracted SMFF	Donjon-SMIT LLC			
	Marine Response Alliance			
	Resolve Marine Group			
	T&T Bisso LLC			
Heading Relative to Wind	15-45 Degrees			
	45-90 Degrees			
	Head On			
Beaufort Scale	Scale	Description	Wind Speed (kt)	Wave Swell (ft)
	0	Calm	0	0
	1	Light Air	1-2	0-1
	2	Light Breeze	3-6	1-2
	3	Gentle Breeze	7-10	2-3.5
	4	Moderate Breeze	11-15	3.5-6
	5	Fresh Breeze	16-20	6-9
	6	Strong Breeze	21-26	9-13
	7	Light Gale	27-33	13-18
	8	Gale	34-40	18-25

By selecting one of the choices provided by the Classification and Heading Relative to Wind dropdowns, the tool inputs values for the wind drag coefficient, block coefficient, and the heading coefficient. Once all information is filled in, the user selects the “Run Program” button and the database carries out all necessary calculations.

The tugs that meet all requirements listed will be marked as green and therefore suitable for the job. Tugs that are able to tow in solely ideal weather conditions will be marked as yellow, meaning that more than one tug may be required in order to complete the tow in the current weather conditions. Finally, tugs that do not meet the criteria at all will be marked as red, and consequently will not be able to respond. This can be seen below in Figure 11.

Qualified Tug List For Distress Situations



SMFF Resource Provider: **All**

Green = Meets All Conditions
 Yellow = Meets Ideal Weather Conditions
 Red = Not Suitable
 [Print Report](#)
 [Return](#)

Vessel	SMFF Resource Provider	Company	Contact	BHP	Bollard Pull	Ideal Weather B	Actual BP Needed
DELTA BILLIE	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	6800	133	69	70
DELTA CATHRYN	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	6800	133	69	70
DELTA DEANNA	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	4400	94	69	70
DELTA LINDA	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	4400	94	69	70
GOLIAH	TT Bisso LLC	Crowley Marine Services	(510) 251-7500	4400	94	69	70
Lynn Marie	Marine Response Alliance, TT Bisso LLC	Foss Maritime	(510) 307-7820	6250	85	69	70
NATOMA	TT Bisso LLC	Sause Bros INC	(562) 901-0365	5700	75	69	70
NAVAJO	TT Bisso LLC	Sause Bros INC	(562) 901-0365	5700	75	69	70
PACIFIC FREEDOM	TT Bisso LLC	K-Sea Transportation	(206) 443-9418	4400	70	69	70
NAKOLO	TT Bisso LLC	K-Sea Transportation	(206) 443-9418	5750	69	69	70
COCHISE	TT Bisso LLC	Sause Bros INC	(562) 901-0365	3750	65	69	70
MIKIONA	TT Bisso LLC	Sause Bros INC	(562) 901-0365	3750	65	69	70
Millennium Star	Donjon-SMIT LLC	Harley Marine	(510) 666-5010	4400	64	69	70

Figure 11: Access Database Output Form

From there, ideally, the Spill Management Team and/or Captain of the Port would be able to quickly and efficiently choose a tugboat that is adequate for the job at hand, taking into account the size of the distressed vessel, how far from shore the situation has taken place, and the current weather conditions. By clicking on the name of the chosen tug, the Captain of the Port will be provided with all specifications on that tug, including a contact number, (view Figure 12 below) allowing a timely dispatch. With all of this information, the Coast Guard can better oversee the whole operation and intervene if they see that there is a more efficient and safe way of handling the emergency response.

Tug Specifications

 Save
 Return

VIN:	<input type="text" value="1078815"/>	
Vessel:	<input type="text" value="DELTA LINDA"/>	
SMFF:	<input type="text" value="TT Bisso LLC"/>	
Company:	<input type="text" value="Baydelta Maritime"/>	
Contact:	<input type="text" value="(415) 693-5800"/>	
LOA:	<input type="text" value="105"/>	ft
Breadth:	<input type="text" value="36"/>	ft
Draft:	<input type="text" value="15"/>	ft
BHP:	<input type="text" value="4400"/>	HP
Bollard Pull:	<input type="text" value="94"/>	Short Tons
TugBoat Purpose:	<input type="text" value="Ocean"/>	

Figure 12: Tug Specification Sheet Example

The program was sent out to multiple individuals for a beta-test. The tool was reviewed for efficiency, accuracy, and ease of use. Overall, the program was found to be practical, easy to use, and a great start. There were however, multiple recommendations. While all recommendations proved helpful, informative and practical, the most pressing were implemented first. For example, it was found that there was a slight error in one of the calculations, therefore throwing off all the results. This was seen as the most important suggestion and was attended to first. Fortunately, this was an easy fix and the correct calculation was provided in the response e-mail. Other recommendations included conversions and improved definitions of characteristics within the prototype. E-mails containing all propositions are located in Appendix F. Suggestions remaining at the completion of the project were incorporated into the recommendation chapter.

6. Conclusion and Recommendations

Based on the 8-weeks spent working in Washington DC, recommendations have been created to help the United States Coast Guard (USCG) and their Vessel Response Program (VRP) continue with this project, and minimize confusion and slow response times in the emergency towing industry. Additionally, conclusions were drawn from the information currently provided on towing vessels, and its impact on the towing industry. These conclusions and recommendations are proposed to the USCG to improve upon the current method of choosing an adequate towing vessel.

6.1 Conclusions

Through the use of the automated prototype database the efficiency and accuracy of emergency response will be significantly enhanced in the Port of San Francisco. It allows the port to quickly see a list of appropriate response vessels according to specific emergency situations. From the list one click allows the port to gather all necessary characteristics on the desired response vessel, including a contact number to verify the response vessel is available.

6.2 Recommendations

Through the research on tugboats and their different characteristics, it became apparent that the current information on these emergency response vessels is not easily accessible. The recommendations aspire to redefine the emergency towing and salvage regulation, to mandate a more uniform system to verify adequate tugboats. From the information provided within this report and the recommendations given, the USCG will be able to make an informed decision about whether or not to incorporate the regulation amendments and expand upon this prototype and implement it nationwide.

6.2.1 Provide Guidance on Regulations for Emergency Towing Vessels

Currently, the USCG regulation is vague when referring to the characteristics required for towing vessels in order to successfully complete tasks related to emergency towing. While calculating bollard pull is the most important factor in figuring out if a tugboat can pull the distressed vessel, there are other characteristics that must be considered in order to determine the effectiveness of a tug in a situation. It is recommended that in the future the USCG provide further guidance in regards to the regulation, including information on;

- The ability of the tug to endure offshore conditions (load line certificates)
- Tow gear on the tug (wires, hookups, etc)
- Firefighting Capabilities

Ability of Emergency Response Vessel to Endure Offshore Conditions

It is important for the tugs to submit data about their ability to travel offshore because situations that occur offshore require specialized tugs. If a tug does not meet the requirements to travel offshore it will neither survive the conditions of the open ocean, nor will it be able to pull the distressed ship. Sending out inadequate tugs causes more problems than the original issue. With the tug masters/tugboat companies not required to submit all the specifications of their vessels, such as load line certification and adequate dimensions (freeboard, draft), the companies and the USCG have difficulties in ensuring the safety of all parties involved in these distress

situations. It is strongly recommended that the submission of tugboats offshore capabilities become a required characteristic in the future.

Tow Gear

Another important piece of information about emergency towing vessels that is not mentioned in the regulation or submitted by all companies is the tow gear on the tug. This tow gear includes the different kinds of towing wires the tug has and its hookups. The wires are extremely important in a towing situation, because if a tug with a large bollard pull has weak wires, it can snap the wires easily putting the crew at risk and at the same time losing the tow. Also, as the use of synthetic lines is becoming more and more popular, but those lines are not as reliable as the traditional cable wires, and are more affected by the salt water. The hookups are a very similar situation to the lines. If they are not rated to handle the stresses being put upon them by the heavy strains they can also snap putting everyone at risk and again causing the tow to be lost. It is recommended that the USCG enforces minimum standards required for all tow gear to be used by emergency response vessels. The tow gear should also be carefully catalogued and inspected to ensure the safety of all parties.

Firefighting Capabilities

Finally, the regulation does not mandate that information on tugboats firefighting capabilities be provided. While this information is not important to the job of emergency towing it is important information to know about every tug. It is recommended that the USCG combine the information already known about tugs and their firefighting capabilities with the current information in the database. By putting all of this information in one place, it will greatly reduce the response time to an emergency situation by making the information more accessible.

It is recommended that the USCG provide guidance on these specifications, because not only will most salvage companies submit the information, but then everyone involved will be on the same page. In order to ensure equality across the board as far as providing services to industry, if every company is required to post all of this information, there will be no competitive edge. The goal of these recommendations is not to create economic issues for the salvage companies, but to improve safety of the marine environment and the shipping community. After learning as much as possible about this problem, it has become apparent that many issues could be prevented if all information was laid out and everyone involved was up to date. By setting these regulations it will be a large step forward in getting everyone informed.

6.2.2 Expansion of Decision Making Tool

It is important to expand upon the prototype database that was created during the course of this project. Furthering developing the tool in multiple areas would result in a faster and more unified way to verify tugboats adequacy and determine which should be sent to respond in an emergency.

Incorporate All Emergency Response Vessels Throughout the Nation

This report focuses on the port of San Francisco, but does not review the tugs throughout the nation. It is strongly recommended that the USCG take this prototype decision-making tool and expand it to include all ports/tugs within the United States. The expansion of this tool would

greatly help all the Captain of the Port (COTP) zones validate the Geographic Specific Appendices (GSAs) much faster than the current method. It will also enforce consistency throughout the COTP zones and salvage companies.

With the addition of all tugboats across the nation, confusion may arise from the overwhelming amount of information. To solve this, it is strongly suggested that the USCG add in filters to sort the tugboats by COTP zones. By choosing the COTP zone nearest to the distressed vessel, the information will be sorted to only output the tugboats from that COTP zone.

Incorporate Real Time Location Data for Emergency Response Vessels

Another recommendation for the USCG is to incorporate the real time location of the tugs into the data base. While learning about the company Donjon-SMIT, it was noted that they have a data base in which the real time location of the tugs is tracked and put onto a map of the world. A user is also able to click on the tug and get specific information about that tug. This is very similar to the original idea of the decision making tool. It is suggested that the USCG look into how Donjon-SMIT created this data base and include something similar to it into the tool. The ideal tool will spit out the tugs in the same green, yellow, red fashion, but from there the name of the tug can then be clicked on. Once clicked, a window will pop up with the specifications of the tug, along with a picture of the tug and its most recently updated location. Then, from the tugs most recent location and its known average speed, the data base would be able to calculate approximately how long it would take the tug to reach the disabled vessel. To perform the real time response calculation, it is suggested to incorporate the average speed of the tugboats into the database. This way there will be no time wasted calling the tug to see where exactly it is and if it can reach the distressed vessel within the time limits set by the USCG regulation.

Create Link on Homeport of USCG Website

In order to expand this tool into a nationwide data base, it is also suggested that the USCG make it into a web link on their website, in which the COTPs can easily access its information. Within this web link, the COTP can access the input form of the data base and enter in the information about the distressed vessel. Once they run the program, the only thing returned to them would be the report on which tugs are suited for the job. This way the COTPs will not have to deal with the vast amount of information held within the data base unless they specifically search for it.

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Appendix A: U.S. Coast Guard

The sponsor for this Interactive Qualifying Project (IQP) is the United States Coast Guard (USCG). The USCG (2011b) is in charge of many important issues pertaining to the security of the United State's coastal borders, seaports and waterways. Within these areas, the USGC has multiple missions, some of which include: drug interdiction, search and rescue, marine environmental protection and marine safety.

The USCG (2011b) is a military organization, run with government funds. While the USCG is a public organization, in order to work full time with them as a civilian, a potential employee must pass a background check performed by the FBI. The USCG is a large organization, currently employing 42,000 men and women on active duty. Like other military branches there is a hierarchy for the USCG stemming from the Executive branch of the government. The diagrams in Figures (13) and (14) show that the USCG jurisdiction falls under the Department of Homeland Security. The USCG follows the same inner command structure as the Navy but remains separate from the naval forces. The Navy is in its own branch of the government, and the two organizations are their own separate entities. For the 2012 fiscal year, the Coast Guard will have a budget of \$6.8 billion. This money will be used for base adjustments, regular maintenance of vessels, systems, etc.

While in Washington, D.C., our group will be working with Patricia Adams and Lieutenant Commander Kevin Ferrie, both of whom work in the Vessel Response Plan Program, within the Office of Vessel Activities (United States Coast Guard, 2010a). This office is located at 2100 Second Street SW, Washington D.C. The main objective of this office of the USCG is to “eliminate the operation of substandard vessels in U.S. waters by effectively administering, managing and implementing commercial vessel safety, security and environmental protection compliance programs in support of applicable international and domestic standards”(para. 1).

Our group will also be working with the Marine Safety Center (MSC) office, which supports the Marine Safety, Security, and Environmental Protection programs established by the U.S. Coast Guard (2011d). Established in 1986, the MSC has independent headquarters located at 2100 Second Street SW, Washington, D.C. As of 2011, this particular office of the USCG has 28 Officers, 23 Civilians, 2 Reservists, and 16 Contract Employees working within it. Currently, the head of the MSC is 25-year USCG veteran Captain Patrick E. Little (United States Coast Guard, 2010e). He received a Bachelor's Degree in Marine Engineering from the Coast Guard Academy in 1986, and also has acquired three Master's Degrees in Naval Architecture, Marine Engineering, and Mechanical Engineering from Massachusetts Institute of Technology in 1994.

Along with its own employees, the USCG (2011b) also collaborates with other government agencies and, if necessary, other countries. Some examples of the other agencies that collaborate with the USCG would be the U.S. Navy, Department of Homeland Security, the Drug Enforcement Agency (DEA), and the Central Intelligence Agency (CIA). In 2011, the USCG, working together with U.S. Customs and Border Protection, captured a drug submarine full of cocaine off the Caribbean coast of Honduras (The Associated Press, 2011). If need be, the USCG can also collaborate with other countries in order to solve shared problems. After training with other countries, the SAR program has never been stronger.

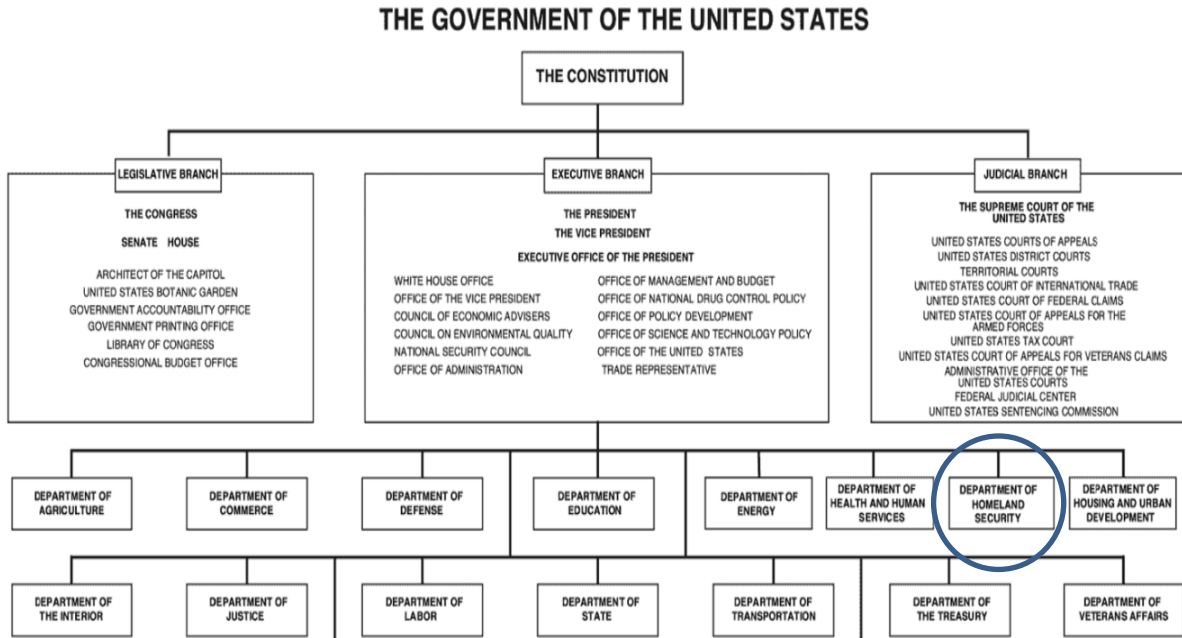
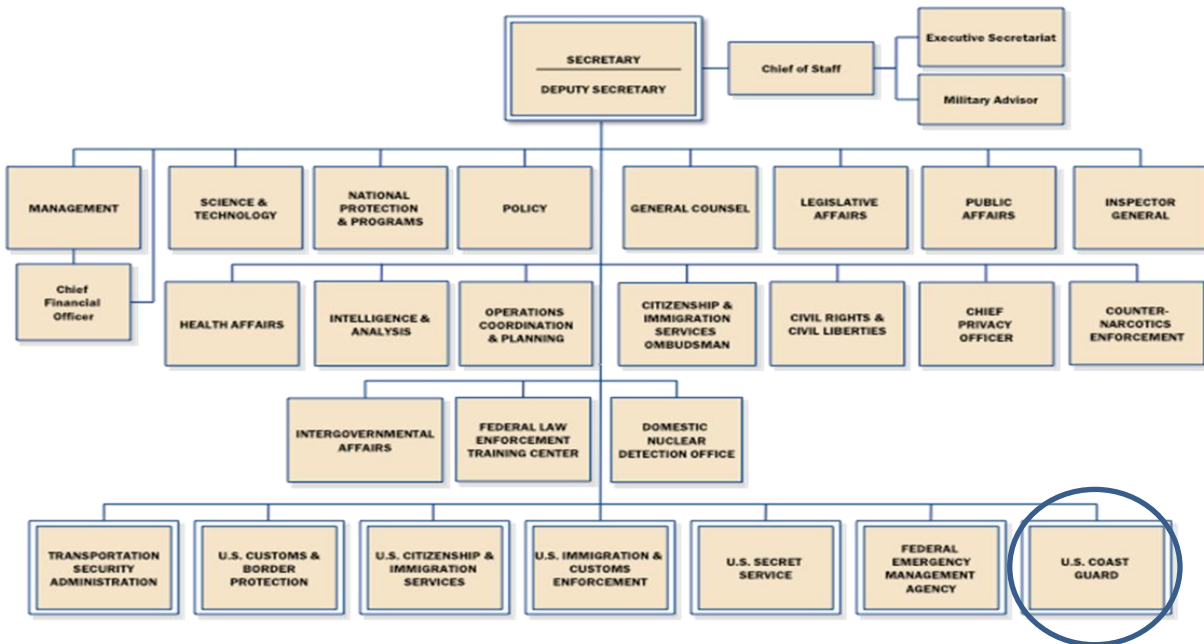


Figure 13: Structure of the U.S. Government (United States Coast Guard, 2011b)



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Figure 14: Department of Homeland Security Organizational Structure (United States Coast Guard, 2011b)

Appendix B: USCG Regulations

Subpart I—Salvage and Marine Firefighting

Source: USCG–1998–3417, 73 FR 80649, Dec. 31, 2008, unless otherwise noted.

§ 155.4010 Purpose of this subpart.

(a) The purpose of this subpart is to establish vessel response plan *salvage* and *marine firefighting* requirements for vessels, that are carrying group I–IV oils, and that are required by §155.1015 to have a vessel response plan. *Salvage* and *marine firefighting* actions can save lives, property, and prevent the escalation of potential oil spills to worst case discharge scenarios.

(b) A planholder must ensure by *contract or other approved means* that response resources are available to respond. However, the response criteria specified in the regulations (e.g., quantities of response resources and their arrival times) are planning criteria, not performance standards, and are based on assumptions that may not exist during an actual incident, as stated in 33 CFR 155.1010. Compliance with the regulations is based upon whether a covered response plan ensures that adequate response resources are available, not on whether the actual performance of those response resources after an incident meets specified arrival times or other planning criteria. Failure to meet specified criteria during an actual spill response does not necessarily mean that the planning requirements of the Federal Water Pollution Control Act (FWPCA) (33 U.S.C. 1251–1376) and regulations were not met. The Coast Guard will exercise its enforcement discretion in light of all facts and circumstances.

§ 155.4015 Vessel owners and operators who must follow this subpart.

You must follow this subpart if your vessel carries group I–IV oils, and is required by §155.1015 to have a vessel response plan.

§ 155.4020 Complying with this subpart.

(a) If you have an existing approved vessel response plan, you must have your vessel response plan updated and submitted to the Coast Guard by February 22, 2011.

(b) All new or existing vessels operating on the navigable waters of the United States or transferring oil in a port or place subject to the jurisdiction of the United States, that meet the applicability requirements of §155.1015, that do not have an approved vessel response plan, must comply with §155.1065.

(c) Your vessel may not conduct oil transport or transfer operations if—

(1) You have not submitted a plan to the Coast Guard in accordance with §155.1065 prior to February 22, 2011;

- (2) The Coast Guard determines that the response resources referenced in your plan do not meet the requirements of this subpart;
- (3) The contracts or agreements cited in your plan have lapsed or are otherwise no longer valid;
- (4) You are not operating in accordance with your plan; or
- (5) The plan's approval has expired.

[USCG–1998–3417, 73 FR 80649, Dec. 31, 2008, as amended by USCG–2001–8661, 74 FR 45029, Aug. 31, 2009]

§ 155.4025 Definitions.

For the purposes of this subpart, the following definitions apply:

Assessment of structural stability means completion of a vessel's stability and structural integrity assessment through the use of a salvage software program. The data used for the calculations would include information collected by the on-scene salvage professional. The assessment is intended to allow sound decisions to be made for subsequent salvage efforts. In addition, the assessment must be consistent with the conditions set forth in 33 CFR 155.240 and 155.245, as applicable.

Boundary lines are lines drawn following the general trend of the seaward, highwater shorelines and lines continuing the general trend of the seaward, highwater shorelines across entrances to small bays, inlets and rivers as defined in 46 CFR 7.5(c).

Captain of the Port (COTP) city means the city which is the geographical location of the COTP office. COTP city locations are listed in 33 CFR part 3.

Continental United States (CONUS) means the contiguous 48 States and the District of Columbia.

Contract or other approved means is any one of the following:

- (1)(i) A written contractual agreement between a vessel owner or operator and resource provider. This agreement must expressly provide that the resource provider is capable of, and intends to commit to, meeting the plan requirements.
- (ii) A written certification that the personnel, equipment, and capabilities required by this subpart are available and under the vessel owner or operator's direct control. If the planholder has personnel, equipment and capabilities under their direct control, they need not contract those items with a resource provider.
- (iii) An alternative approved by the Coast Guard (Commandant, Director of Prevention Policy (CG–54)) and submitted in accordance with 33 CFR 155.1065(f).

(2) As part of the contract or other approved means you must develop and sign, with your resource provider, a written funding agreement. This funding agreement is to ensure that salvage and marine firefighting responses are not delayed due to funding negotiations. The funding agreement must include a statement of how long the agreement remains in effect, and must be provided to the Coast Guard for VRP approval. In addition any written agreement with a public resource provider must be included in the planholder's Vessel Response Plan (VRP).

Diving services support means divers and their equipment to support salvage operations. This support may include, but not be limited to, underwater repairs, welding, placing lifting slings, or performing damage assessments.

Emergency lightering is the process of transferring oil between two ships or other floating or land-based receptacles in an emergency situation and may require pumping equipment, transfer hoses, fenders, portable barges, shore based portable tanks, or other equipment that circumstances may dictate.

Emergency towing, also referred to as rescue towing, means the use of towing vessels that can pull, push or make-up alongside a vessel. This is to ensure that a vessel can be stabilized, controlled or removed from a grounded position. Towing vessels must have the proper horsepower or bollard pull compatible with the size and tonnage of the vessel to be assisted.

External emergency transfer operations means the use of external pumping equipment placed on board a vessel to move oil from one tank to another, when the vessel's own transfer equipment is not working.

External firefighting teams means trained firefighting personnel, aside from the crew, with the capability of boarding and combating a fire on a vessel.

External vessel firefighting systems mean firefighting resources (personnel and equipment) that are capable of combating a fire from other than on board the vessel. These resources include, but are not limited to, fire tugs, portable fire pumps, airplanes, helicopters, or shore side fire trucks.

Funding agreement is a written agreement between a resource provider and a planholder that identifies agreed upon rates for specific equipment and services to be made available by the resource provider under the agreement. The funding agreement is to ensure that salvage and marine firefighting responses are not delayed due to funding negotiations. This agreement must be part of the contract or other approved means and must be submitted for review along with the VRP.

Great Lakes means Lakes Superior, Michigan, Huron, Erie, and Ontario, their connecting and tributary waters, the Saint Lawrence River as far as Saint Regis, and adjacent port areas.

Heavy lift means the use of a salvage crane, A-frames, hydraulic jacks, winches, or other equipment for lifting, righting, or stabilizing a vessel.

Inland area means the area shoreward of the boundary lines defined in 46 CFR part 7, except that in the Gulf of Mexico, it means the area shoreward of the lines of demarcation (COLREG lines) as defined in §§80.740 through 80.850 of this chapter. The inland area does not include the Great Lakes.

Making temporary repairs means action to temporarily repair a vessel to enable it to safely move to a shipyard or other location for permanent repairs. These services include, but are not limited to, shoring, patching, drill stopping, or structural reinforcement.

Marine firefighting means any firefighting related act undertaken to assist a vessel with a potential or actual fire, to prevent loss of life, damage or destruction of the vessel, or damage to the marine environment.

Marine firefighting pre-fire plan means a plan that outlines the responsibilities and actions during a marine fire incident. The principle purpose is to explain the resource provider's role, and the support which can be provided, during marine firefighting incidents. Policies, responsibilities and procedures for coordination of on-scene forces are provided in the plan. It should be designed for use in conjunction with other state, regional and local contingency and resource mobilization plans.

Nearshore area means the area extending seaward 12 miles from the boundary lines defined in 46 CFR part 7, except in the Gulf of Mexico. In the Gulf of Mexico, a nearshore area is one extending seaward 12 miles from the line of demarcation (COLREG lines) as defined in §§80.740 through 80.850 of this chapter.

Offshore area means the area up to 38 nautical miles seaward of the outer boundary of the nearshore area.

On-site fire assessment means that a marine firefighting professional is on scene, at a safe distance from the vessel or on the vessel, who can determine the steps needed to control and extinguish a marine fire in accordance with a vessel's stability and structural integrity assessment if necessary.

On-site salvage assessment means that a salvage professional is on scene, at a safe distance from the vessel or on the vessel, who has the ability to assess the vessel's stability and structural integrity. The data collected during this assessment will be used in the salvage software calculations and to determine necessary steps to save the vessel.

Other refloating methods means those techniques for refloating a vessel aside from using pumps. These services include, but are not limited to, the use of pontoons, air bags or compressed air.

Outside continental United States (OCONUS) means Alaska, Hawaii, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Commonwealth of the Northern Marianas, and any other territory or possession of the United States.

Primary resource provider means a resource provider listed in the vessel response plan as the principal entity contracted for providing specific salvage and/or marine firefighting services and resources, when multiple resource providers are listed for that service, for each of the COTP zones in which a vessel operates. The primary resource provider will be the point of contact for the planholder, the Federal On Scene Coordinator (FOSC) and the Unified Command, in matters related to specific resources and services, as required in §155.4030(a).

Remote assessment and consultation means contacting the salvage and/or marine firefighting resource providers, by phone or other means of communications to discuss and assess the situation. The person contacted must be competent to consult on a determination of the appropriate course of action and initiation of a response plan.

Resource provider means an entity that provides personnel, equipment, supplies, and other capabilities necessary to perform salvage and/or marine firefighting services identified in the response plan, and has been arranged by contract or other approved means. The resource provider must be selected in accordance with §155.4050. For marine firefighting services, resource providers can include public firefighting resources as long as they are able, in accordance with the requirements of §155.4045(d), and willing to provide the services needed.

Salvage means any act undertaken to assist a vessel in potential or actual danger, to prevent loss of life, damage or destruction of the vessel and release of its contents into the marine environment.

Salvage plan means a plan developed to guide salvage operations except those identified as specialized salvage operations.

Special salvage operations plan means a salvage plan developed to carry out a specialized salvage operation, including heavy lift and/or subsurface product removal.

Subsurface product removal means the safe removal of oil from a vessel that has sunk or is partially submerged underwater. These actions can include pumping or other means to transfer the oil to a storage device.

Underwater vessel and bottom survey means having salvage resources on scene that can perform examination and analysis of the vessel's hull and equipment below the water surface. These resources also include the ability to determine the bottom configuration and type for the body of water. This service can be accomplished through the use of equipment such as sonar, magnetometers, remotely operated vehicles or divers. When divers are used to perform these services, the time requirements for this service apply and not those of diving services support.

§ 155.4030 Required salvage and marine firefighting services to list in response plans.

(a) You must identify, in the geographical-specific appendices of your VRP, the *salvage and marine firefighting* services listed in Table 155.4030(b)—Salvage and Marine Firefighting Services and Response Timeframes. Additionally, you must list those *resource providers* that you have contracted to provide these services. You may list multiple *resource providers* for each

service, but you must identify which one is your primary *resource provider* for each Captain of the Port (COTP) zone in which you operate. A method of contact, consistent with the requirements in §§155.1035(e)(6)(ii) and 155.1040(e)(5)(ii), must also be listed, in the geographical-specific appendices of your VRP, adjacent to the name of the *resource provider*.

(b) Table 155.4030(b) lists the required *salvage* and *marine firefighting* services and response timeframes.

Table 155.4030(b)—Salvage and Marine Firefighting Services and Response Timeframes

Service	Location of incident response activity timeframe	
(1) Salvage	CONUS: nearshore area; inland waters; Great Lakes; and OCONUS: < or = 12 miles from COTP city (hours)	CONUS: offshore area; and OCONUS: < or = 50 miles from COTP city (hours)
(i) <i>Assessment & Survey:</i>		
(A) Remote assessment and consultation	1	1
(B) Begin assessment of structural stability	3	3
(C) On-site salvage assessment	6	12
(D) Assessment of structural stability	12	18
(E) Hull and bottom survey	12	18
(ii) <i>Stabilization:</i>		
(A) Emergency towing	12	18
(B) Salvage plan	16	22
(C) External emergency transfer operations	18	24
(D) Emergency lightering	18	24
(E) Other refloating methods	18	24
(F) Making temporary repairs	18	24
(G) Diving services support	18	24
(iii) <i>Specialized Salvage Operations:</i>		

(A) Special salvage operations plan		18	24
(B) Subsurface product removal		72	84
(C) Heavy lift ¹		Estimated	Estimated
(2) Marine firefighting	At pier (hours)	CONUS: Nearshore area; inland waters; Great Lakes; and OCONUS: < or = 12 miles from COTP city (hours)	CONUS: Offshore area; and OCONUS: < or = 50 miles from COTP city (hours)
<i>(i) Assessment & Planning:</i>			
(A) Remote assessment and consultation	1	1	1
(B) On-site fire assessment	2	6	12
<i>(ii) Fire Suppression:</i>			
(A) External firefighting teams	4	8	12
(B) External vessel firefighting systems	4	12	18

¹Heavy lift services are not required to have definite hours for a response time. The planholder must still contract for heavy lift services, provide a description of the heavy lift response and an estimated response time when these services are required, however, none of the timeframes listed in the table in §155.4030(b) will apply to these services.

(c) *Integration into the response organization.* You must ensure that all *salvage and marine firefighting resource providers* are integrated into the response organizations listed in your plans. The response organization must be consistent with the requirements set forth in §§155.1035(d), 155.1040(d) and 155.1045(d).

(d) *Coordination with other response resource providers, response organizations and OSROs.* Your plan must include provisions on how the salvage and marine firefighting resource providers will coordinate with other response resources, response organizations, and OSROs. For example, you will need to identify how salvage and marine firefighting assessment personnel will coordinate response activity with oil spill removal organizations. For services that, by law, require public assistance, there must be clear guidelines on how service providers will interact with those organizations. The information contained in the response plan must be consistent with applicable Area Contingency Plans (ACPs) and the National Oil and Hazardous Substances Pollution Contingency Plan as found in §155.1030(h).

(e) *Ensuring the proper emergency towing vessels are listed in your VRP.* Your VRP must identify towing vessels with the proper characteristics, horsepower, and bollard pull to tow your vessel(s). These towing vessels must be capable of operating in environments where the winds are up to 40 knots.

(f) *Ensuring the proper type and amount of transfer equipment is listed in your VRP.* Your salvage resource provider must be able to bring on scene a pumping capability that can offload the vessel's largest cargo tank in 24 hours of continuous operation. This is required for both emergency transfer and lightering operations.

(g) *Ensuring firefighting equipment is compatible with your vessel.* Your plan must list the proper type and amount of extinguishing agent needed to combat a fire involving your vessel's cargo, other contents, and superstructure. If your primary extinguishing agent is foam or water, you must identify resources in your plan that are able to pump, for a minimum of 20 minutes, at least 0.016 gallons per minute per square foot of the deck area of your vessel, or an appropriate rate for spaces that this rate is not suitable for and if needed, an adequate source of foam. These resources described are to be supplied by the resource provider, external to the vessel's own firefighting system.

(h) *Ensuring the proper subsurface product removal.* You must have subsurface product removal capability if your vessel(s) operates in waters of 40 feet or more. Your resource provider must have the capability of removing cargo and fuel from your sunken vessel to a depth equal to the maximum your vessel operates in up to 150 feet.

[USCG–1998–3417, 73 FR 80649, Dec. 31, 2008; 74 FR 7648, Feb. 19, 2009; USCG–2010–0351, 75 FR 36285, June 25, 2010]

§ 155.4032 Other resource provider considerations.

(a) *Use of resource providers not listed in the VRP.* If another resource provider, not listed in the approved plan for the specific service required, is to be contracted for a specific response, justification for the selection of that resource provider needs to be provided to, and approved by, the FOSC. Only under exceptional circumstances will the FOSC authorize deviation from the resource provider listed in the approved vessel response plan in instances where that would best affect a more successful response.

(b) *Worker health and safety.* Your resource providers must have the capability to implement the necessary engineering, administrative, and personal protective equipment controls to safeguard their workers when providing salvage and marine firefighting services, as found in 33 CFR 155.1055(e) and 29 CFR 1910.120(q).

§ 155.4035 Required pre-incident information and arrangements for the salvage and marine firefighting resource providers listed in response plans.

(a) You must provide the information listed in §§155.1035(c) and 155.1040(c) to your salvage and marine firefighting resource providers.

(b) *Marine firefighting pre-fire plan* . (1) You must prepare a vessel pre-fire plan in accordance with NFPA 1405, Guide for Land-Based Firefighters Who Respond to Marine Vessel Fires, Chapter 9 (Incorporation by reference, *see* §155.140). If the planholder's vessel pre-fire plan is one that meets another regulation, such as SOLAS Chapter II–2, Regulation 15, or international standard, a copy of that specific fire plan must also be given to the resource provider(s) instead of the NFPA 1405 pre-fire plan, and be attached to the VRP.

(2) The marine firefighting resource provider(s) you are required to identify in your plan must be given a copy of the plan. Additionally, they must certify in writing to you that they find the plan acceptable and agree to implement it to mitigate a potential or actual fire.

(3) If a marine firefighting resource provider subcontracts to other organizations, each subcontracted organization must also receive a copy of the vessel pre-fire plan.

[USCG–1998–3417, 73 FR 80649, Dec. 31, 2008, as amended by USCG–2010–0351, 75 FR 36285, June 25, 2010]

§ 155.4040 Response times for each salvage and marine firefighting service.

(a) You must ensure, by contract or other approved means, that your resource provider(s) is capable of providing the services within the required timeframes.

(1) If your vessel is at the pier or transiting a COTP zone within the continental United States (CONUS), the timeframes in Table 155.4030(b) apply as listed.

(2) If your vessel is at the pier or transiting a COTP zone outside the continental United States (OCONUS), the timeframes in Table 155.4030(b) apply as follows:

(i) Inland waters and nearshore area timeframes apply from the COTP city out to and including the 12 mile point.

(ii) Offshore area timeframes apply from 12 to 50 miles outside the COTP city.

(3) If your vessel transits within an OCONUS COTP zone that is outside the areas described in paragraph (a)(2) of this section, but within the inland waters or the nearshore or offshore area, you must submit in writing, in your plan, the steps you will take to address salvage and marine firefighting needs in the event these services are required.

(b) The timeframe starts when anyone in your response organization receives notification of a potential or actual incident. It ends when the service reaches the ship, the outer limit of the nearshore area, the outer limit of the offshore area, the 12 or 50-mile point from the COTP city, or a point identified in your response plan for areas OCONUS.

(c) Table 155.4040(c) provides additional amplifying information for vessels transiting within the nearshore and offshore areas of CONUS or within 50 miles of an OCONUS COTP city.

Table 155.4040(c)—Response Timeframe End Points

Service	Response timeframe ends when
(1) Salvage:	
(i) Remote assessment and consultation	Salvor is in voice contact with Qualified Individual (QI)/Master/Operator.
(ii) Begin assessment of structural stability	A structural assessment of the vessel has been initiated.
(iii) On-site salvage assessment	Salvor on board vessel.
(iv) Assessment of structural stability	Initial analysis is completed. This is a continual process, but at the time specified an analysis needs to be completed.
(v) Hull and bottom survey	Survey completed.
(vi) Emergency towing	Towing vessel on scene.
vii) Salvage plan	Plan completed and submitted to Incident Commander/Unified Command.
(viii) External emergency transfer operations	External pumps on board vessel.
(ix) Emergency lightering	Lightering equipment on scene and alongside.
(x) Other refloating methods	Salvage plan approved & resources on vessel.
(xi) Making temporary repairs	Repair equipment on board vessel.
(xii) Diving services support	Required support equipment & personnel on scene.
(xiii) Special salvage operations plan	Plan completed and submitted to Incident Commander/Unified Command.
(xiv) Subsurface product removal	Resources on scene.
(xv) Heavy lift ¹	Estimated.
(2) Marine Firefighting:	
(i) Remote assessment and consultation	Firefighter in voice contact with QI/Master/Operator.
(ii) On-site fire	Firefighter representative on site.

assessment	
(iii) External firefighting teams	Team and equipment on scene.
(iv) External vessel firefighting systems	Personnel and equipment on scene.

¹Heavy lift services are not required to have definite hours for a response time. The planholder must still contract for heavy lift services, provide a description of the heavy lift response and an estimated response time when these services are required, however, none of the timeframes listed in the table in §155.4030(b) will apply to these services.

(d) *How to apply the timeframes to your particular situation* . To apply the timeframes to your vessel's situation, follow these procedures:

(1) Identify if your vessel operates CONUS or OCONUS.

(2) If your vessel is calling at any CONUS pier or an OCONUS pier within 50 miles of a COTP city, you must list the pier location by facility name or city and ensure that the marine firefighting resource provider can reach the locations within the specified response times in Table 155.4030(b).

(3) If your vessel is transiting within CONUS inland waters, nearshore or offshore areas or the Great Lakes, you must ensure the listed salvage and marine firefighting services are capable of reaching your vessel within the appropriate response times listed in Table 155.4030(b).

(4) If your vessel is transiting within 12 miles or less from an OCONUS COTP city, you must ensure the listed salvage and marine firefighting services are capable of reaching a point 12 miles from the harbor of the COTP city within the nearshore area response times listed in Table 155.4030(b).

(5) If your vessel is transiting between 12 and 50 miles from an OCONUS COTP city, you must ensure the listed salvage and marine firefighting services are capable of reaching a point 50 miles from the harbor of the COTP city within the offshore area response times listed in Table 155.4030(b).

(6) If your vessel transits inland waters or the nearshore or offshore areas OCONUS, but is more than 50 miles from a COTP city, you must still contract for salvage and marine firefighting services and provide a description of how you intend to respond and an estimated response time when these services are required, however, none of the time limits listed in Table 155.4030(b) will apply to these services.

§ 155.4045 Required agreements or contracts with the salvage and marine firefighting resource providers.

(a) You may only list resource providers in your plan that have been arranged by contract or other approved means.

(b) You must obtain written consent from the resource provider stating that they agree to be listed in your plan. This consent must state that the resource provider agrees to provide the services that are listed in §§155.4030(a) through 155.4030(h), and that these services are capable of arriving within the response times listed in Table 155.4030(b). This consent may be included in the contract with the resource provider or in a separate document.

(c) This written consent must be available to the Coast Guard for inspection. The response plan must identify the location of this written consent, which must be:

(1) On board the vessel; or

(2) With a qualified individual located in the United States.

(d) Public marine firefighters may only be listed out to the maximum extent of the public resource's jurisdiction, unless other agreements are in place. A public marine firefighting resource may agree to respond beyond their jurisdictional limits, but the Coast Guard considers it unreasonable to expect public marine firefighting resources to do this.

§ 155.4050 Ensuring that the salvors and marine firefighters are adequate.

(a) You are responsible for determining the adequacy of the resource providers you intend to include in your plan.

(b) When determining adequacy of the resource provider, you must select a resource provider that meets the following selection criteria to the maximum extent possible:

(1) *Resource provider* is currently working in response service needed.

(2) *Resource provider* has documented history of participation in successful salvage and/or marine firefighting operations, including equipment deployment.

(3) *Resource provider* owns or has contracts for equipment needed to perform response services.

(4) *Resource provider* has personnel with documented training certification and degree experience (Naval Architecture, Fire Science, etc.).

(5) *Resource provider* has 24-hour availability of personnel and equipment, and history of response times compatible with the time requirements in the regulation.

(6) *Resource provider* has on-going continuous training program. For marine firefighting providers, they meet the training guidelines in NFPA 1001, 1005, 1021, 1405, and 1561 (Incorporation by reference, see §155.140), show equivalent training, or demonstrate qualification through experience.

- (7) *Resource provider* has successful record of participation in drills and exercises.
- (8) *Resource provider* has salvage or marine firefighting plans used and approved during real incidents.
- (9) *Resource provider* has membership in relevant national and/or international organizations.
- (10) *Resource provider* has insurance that covers the salvage and/or marine firefighting services which they intend to provide.
- (11) *Resource provider* has sufficient up front capital to support an operation.
- (12) *Resource provider* has equipment and experience to work in the specific regional geographic environment(s) that the vessel operates in (e.g., bottom type, water turbidity, water depth, sea state and temperature extremes).
- (13) *Resource provider* has the logistical and transportation support capability required to sustain operations for extended periods of time in arduous sea states and conditions.
- (14) *Resource provider* has the capability to implement the necessary engineering, administrative, and personal protective equipment controls to safeguard the health and safety of their workers when providing salvage and marine firefighting services.
- (15) *Resource provider* has familiarity with the salvage and marine firefighting protocol contained in the local ACPs for each COTP area for which they are contracted.
- (c) A *resource provider* need not meet all of the selection criteria in order for you to choose them as a provider. They must, however, be selected on the basis of meeting the criteria to the maximum extent possible.
- (d) You must certify in your plan that these factors were considered when you chose your resource provider.

§ 155.4052 Drills and exercises.

- (a) A vessel owner or operator required by §§155.1035 and 155.1040 to have a response plan shall conduct exercises as necessary to ensure that the plan will function in an emergency. Both announced and unannounced exercises must be included.
- (b) The following are the minimum exercise requirements for vessels covered by this subpart:
- (1) Remote assessment and consultation exercises, which must be conducted quarterly;
- (2) Emergency procedures exercises, which must be conducted quarterly;

- (3) Shore-based salvage and shore-based marine firefighting management team tabletop exercises, which must be conducted annually;
- (4) Response provider equipment deployment exercises, which must be conducted annually;
- (5) An exercise of the entire response plan, which must be conducted every three years. The vessel owner or operator shall design the exercise program so that all components of the response plan are exercised at least once every three years. All of the components do not have to be exercised at one time; they may be exercised over the 3-year period through the required exercises or through an area exercise; and
- (6) Annually, at least one of the exercises listed in §155.4052(b)(2) and (4) must be unannounced. An unannounced exercise is one in which the personnel participating in the exercise have not been advised in advance of the exact date, time, or scenario of the exercise.
- (7) Compliance with the National Preparedness for Response Exercise Program (PREP) Guidelines will satisfy the vessel response plan exercise requirements. These guidelines are available on the Internet at <https://Homeport.uscg.mil/exercises> . Once on that Web site, select the link for “Preparedness for Response Exercise Program (PREP)” and then select “Preparedness for Response Exercise Program (PREP) Guidelines”. Compliance with an alternate program that meets the requirements of 33 CFR 155.1060(a), and has been approved under 33 CFR 155.1065 will also satisfy the vessel response plan exercise requirements.

§ 155.4055 Temporary waivers from meeting one or more of the specified response times.

- (a) You may submit a request for a temporary waiver of a specific response time requirement, if you are unable to identify a resource provider who can meet the response time.
- (b) Your request must be specific as to the COTP zone, operating environment, salvage or marine firefighting service, and response time.
- (c) Emergency lightering requirements set forth in §155.4030(b) will not be subject to the waiver provisions of this subpart.
- (d) You must submit your request to the Commandant, Director of Prevention Policy (CG–54), via the local COTP for final approval. The local COTP will evaluate and comment on the waiver before forwarding the waiver request, via the District to the Commandant (CG–54) for final approval.
- (e) Your request must include the reason why you are unable to meet the time requirements. It must also include how you intend to correct the shortfall, the time it will take to do so, and what arrangements have been made to provide the required response resources and their estimated response times.
- (f) Commandant, Director of Prevention Policy (CG–54), will only approve waiver requests up to a specified time period, depending on the service addressed in the waiver request, the

operating environment, and other relevant factors. These time periods are listed in Table 155.4055(g).

(g) Table 155.4055(g) lists the service waiver time periods.

Table 155.4055(g)—Service Waiver Time Periods

Service	Maximum waiver time period (years)
(1) Remote salvage assessment & consultation	0
(2) Remote firefighting assessment & consultation	0
(3) On-site salvage & firefighting assessment	1
(4) Hull and bottom survey	2
(5) Salvage stabilization services	3
(6) Fire suppression services	4
(7) Specialized salvage operations	5

(h) You must submit your waiver request 30 days prior to any plan submission deadlines identified in this or any other subpart of part 155 in order for your vessel to continue oil transport or transfer operations.

Title 46: Shipping

PART 42—DOMESTIC AND FOREIGN VOYAGES BY SEA

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Subpart 42.03—Application

§ 42.03-5 U.S.-flag vessels subject to the requirements of this subchapter.

(a) *Vessels engaged in foreign voyages or international voyages other than solely Great Lakes voyages.* (1) All U.S. flag vessels which engage in foreign voyages or international voyages by sea (other than solely in Great Lakes voyages) are subject to this part; except the following:

- (i) Ships of war;
- (ii) New vessels of less than 79 feet in length;
- (iii) Existing vessels of less than 150 gross tons;
- (iv) Pleasure yachts not engaged in trade; and
- (v) Fishing vessels.

(2) As provided in Article 4(4) of the 1966 Convention, in order for existing vessels to take advantage of any reduction in freeboards from those previously assigned, the regulations in Subparts 42.13 to 42.25, inclusive, of this part shall be fully complied with. Except for due cause, such vessels shall not be required to increase their freeboards under the provisions of the 1966 Convention.

(3) All U.S.-flag vessels authorized to engage in foreign or international voyages may also engage in domestic voyages by sea and, as permitted by §45.9 of this part and Part 47 of this subchapter, in Great Lakes voyages without additional load line marks and/or certificates. Where additional load line marks and certificates are provided to specifically cover “Special Service, Coastwise” or “Great Lakes” operation, such vessels are subject to the applicable provisions of Parts 44 and 45 of this subchapter.

(b) *Vessels engaged in domestic voyages by sea.* (1) All U.S.-flag vessels which engage in domestic voyages by sea (coastwise and intercoastal voyages) shall be subject to the applicable provisions of this part except the following:

- (i) Merchant vessels of less than 150 gross tons.
- (ii) Vessels which are mechanically propelled and numbered by a State or the Coast Guard under the Federal Boat Safety Act of 1971 (46 U.S.C. 1451 et seq.) and not required by other laws to be inspected or certified by the U.S. Coast Guard. (This exception includes all mechanically propelled vessels of less than 150 gross tons, and uninspected motor propelled oceanographic vessels of less than 300 gross tons while operating pursuant to 46 U.S.C. 2113.

- (iii) Pleasure craft not used or engaged in trade or commerce.
 - (iv) Barges of less than 150 gross tons.
 - (v) Vessels engaged exclusively in voyages on waters within the United States or its possessions and which are determined not to be “coastwise” or “Great Lakes” voyages.
 - (vi) Ships of war.
 - (vii) U.S. public vessels other than those vessels of 150 gross tons or over and engaged in commercial activities.
- (2) In order for existing vessels to take advantage of any reduction in freeboards from those previously assigned, paragraph (a)(2) of this section applies.
- (c) *Vessels engaged solely on Great Lakes voyages.* A U.S. flag vessel 79 feet and more and 150 gross tons or over that engages solely on Great Lakes voyages is subject to the applicable provisions of this part and Part 45 of this subchapter and must comply with the regulations in force on the date the keel is laid or a similar progress in construction is made.
 - (d) *Special service coastwise voyage.* A U.S. flag vessel 150 gross tons or over that engages in a “special service coastwise voyage” is subject to the applicable provisions of this part and Part 44 of this subchapter.
 - (e) *Hopper dredges engaged in limited service domestic voyages.* Self-propelled hopper dredges over 79 feet (24 meters) in length with working freeboards, on limited service domestic voyages within 20 nautical miles (37 kilometers) from the mouth of a harbor of safe refuge, are subject to the provisions of this subchapter that apply to a Type “B” vessel and to the provisions of Subpart E of Part 44 of this chapter.

[CGFR 68–60, 33 FR 10049, July 12, 1968, as amended by CGFR 68–126, 34 FR 9011, June 5, 1969; CGD 73–49R, 38 FR 12289, May 10, 1973; CGD 80–120, 47 FR 5721, Feb. 8, 1982; CGD 86–016, 51 FR 9962, Mar. 24, 1986; CDG 76–080, 54 FR 36976, Sept. 6, 1989; CGD 97–057, 62 FR 51043, Sept. 30, 1997]

§ 42.03-10 Foreign vessels subject to this subchapter.

- (a) *General.* All existing foreign merchant vessels of 150 gross tons or over, and new foreign vessels of 79 feet in length or more, loading at or proceeding from any port or place within the jurisdiction of the United States or its possessions for a foreign voyage by sea, or arriving within the jurisdiction of the United States or its possessions from a foreign voyage by sea, in both cases the Great Lakes excepted, are subject to 46 U.S.C. 5101–5116, and the regulations in this part applicable to such service. All foreign merchant vessels of 150 gross tons or over, loading at or proceeding from any port or place within the United States on the Great Lakes of North America, or arriving within the jurisdiction of the United States on the Great Lakes, are subject to 46 U.S.C. 5101–5116 and the regulations in part 45 of this subchapter applicable to such service.

(b) *Canadian vessels.* All vessels of Canadian registry and holding valid certificates issued pursuant to Canadian laws and regulations are assumed to be in compliance with the applicable provisions of 46 U.S.C. 5101–5116, the International Convention on Load Lines, 1966, and the regulations in this subchapter.

(c) *Vessels of countries signatory to or adhering to the 1966 Convention.* The enforcement and control of load line requirements regarding vessels of countries signatory to or adhering to The International Convention on Load Lines, 1966, (the 1966 Convention) are as described in §42.07–60 in this part, which is in accord with provisions of Article 21 of the 1966 Convention. Such vessels when holding currently valid certificates issued pursuant to the 1966 Convention, or recognized under such Convention, are assumed to be in compliance with the applicable provisions of such Convention. Such vessels are deemed to be in compliance with the load line requirements found to be equally effective as those established in this part and therefore in compliance with the applicable load line provisions of 46 U.S.C. 5101–5116, as amended, and the regulations in this part as authorized by such laws. Vessels engaged in navigation on the Great Lakes are subject to application of seasonal international marks as specified in Part 45 of this subchapter.

(d) *Vessels of countries not signatory to or adhering to the 1966 Convention.* (1) Vessels of countries not signatory to or adhering to the 1966 Convention, when within the jurisdiction of the United States, shall be subject to 46 U.S.C. 5101–5116, and the regulations in this subchapter as authorized by such laws.

(2) Vessels of countries signatory to or adhering only to International Load Line Convention, London, 1930 (the 1930 Convention), and holding valid certificates issued under that Convention, are subject to the applicable law described in paragraph (a) of this section and the regulations prescribed thereunder in this subchapter.

[CGD 80–120, 47 FR 5722, Feb. 8, 1982, as amended by CGD 97–057, 62 FR 51043, Sept. 30, 1997; USCG–1998–4442, 63 FR 52190, Sept. 30, 1998]

§ 42.03-15 The Great Lakes of North America.

(a) The term “Great Lakes of North America” means those waters of North America which are defined in §42.05–40, and in the exception in Article 5(2)(a) of the 1966 Convention.

(b) The expressions in the regulations in this part, such as “voyages by sea,” “proceed to sea,” “arrive from the high seas,” etc., shall be construed as having no application to voyages on the Great Lakes or portions thereof unless specifically provided otherwise in Part 45 of this subchapter.

[CGFR 68–60, 33 FR 10050, July 12, 1968]

§ 42.03-17 Special load line marks for vessels carrying timber deck cargo.

(a) Certain vessels having load line marks not related to carriage of timber deck cargo may be assigned timber load lines if they are in compliance with the applicable requirements governing timber deck cargoes in this subchapter. The timber load lines apply and may be used only when the vessel is carrying timber deck cargo.

(b) A new or existing vessel having timber load lines assigned to it, when carrying timber deck cargo, may be loaded to the vessel's timber load line applicable to the voyage and season.

[CGFR 68–60, 33 FR 10050, July 12, 1968, as amended by CGD 80–120, 47 FR 5722, Feb. 8, 1982]

§ 42.03-20 Equivalents.

(a) Where in this subchapter it is provided that a particular fitting, material, appliance, apparatus, or equipment, or type thereof, shall be fitted or carried in a vessel, or that a particular provision shall be made or arrangement shall be adopted, the assigning authority, with the prior approval of the Commandant, may accept in substitution therefor any other fitting, material, apparatus, or equipment or type thereof, or any other provision or arrangement: *Provided*, That it can be demonstrated by trial thereof or otherwise that the substitution is at least as effective as that required by the regulations in this subchapter.

(b) In any case where it is shown to the satisfaction of the assigning authority and the Commandant that the use of any particular equipment, apparatus, or arrangement not specifically required by law is unreasonable or impracticable, appropriate alternatives may be permitted under such conditions as are consistent with the minimum standards set forth in this subchapter.

[CGFR 68–60, 33 FR 10050, July 12, 1968]

§ 42.03-25 Experimental installations.

(a) Complete information (including plans, necessary instructions and limitations, if any) on proposed experimental installations affecting any fitting, material, appliance, apparatus, arrangement, or otherwise shall be submitted to the assigning authority for evaluation. After acceptance by the assigning authority, the complete information of such installation shall be forwarded to the Commandant for specific approval prior to installation. Complete information shall also be furnished for any associated installation(s) deemed necessary to prevent endangering the vessel during the trial period of proposed experimental installations.

(b) The use of approved experimental installations shall be permitted only when in accordance with instructions and limitations as specifically prescribed for such installations by the Commandant.

[CGFR 68–60, 33 FR 10050, July 12, 1968]

§ 42.03-30 Exemptions for vessels.

(a) For an individual vessel or category of vessels, upon the specific recommendation of the assigning authority, the Commandant may authorize an exemption from one or more load line requirements. Such recommendation and authorization will depend upon provision of any additional features as deemed necessary by the authorities to ensure the vessel's safety in the services and under the conditions specified in paragraph (b) of this section.

(b) Exemptions from specific load line requirements for vessels meeting requirements of paragraph (a) of this section are authorized, subject to certain conditions, including type of voyage engaged in, as follows:

(1) For vessels engaged on international voyages between the United States and near neighboring ports of its possessions or of foreign countries. The exemptions may be permitted because the requirements are deemed to be unreasonable or impracticable due to the sheltered nature of the waters on which the voyages occur or other conditions. These exemptions shall be valid only so long as such a vessel shall remain engaged on specific designated voyages. If the voyage involves a foreign country or countries, the United States will require an exemption agreement with such country or countries prior to the issuance of the appropriate load line certificate.

(2) For vessels engaged on international voyages which embody features of a novel kind, and where nonexemption may seriously impede research, development, and incorporation of novel features into vessels. If the voyage or voyages intended involve a foreign country or countries, then the United States will require an exemption agreement with such country or countries prior to the issuance of a Load Line Exemption Certificate. If the Commandant grants an exemption pursuant to this paragraph (b)(2) to a U.S. flag vessel that operates on the Great Lakes of North America, he may notify the Chairman of the Board of Steamship Inspection of Canada of the nature of the exemption, but no special exemption certificate is issued.

(3) For a vessel not normally engaged on international voyages but which is required to undertake a single international voyage under exceptional circumstances.

(4) For self-propelled hopper dredges engaged on international voyages or on limited service domestic voyages by sea. These vessels may be exempt from applicable hatch cover requirements of §42.15-25 of this part by showing they meet the requirements in §174.310 of this chapter. When a Load Line Exemption Certificate is issued for this exemption, it must have an endorsement that only seawater is allowed in the vessel's hoppers.

(c) A vessel given one or more exemptions from load line requirements under the provisions of paragraph (b)(1) of this section will be issued the appropriate load line certificate, using Form A1, A2, or A3. In each case the exemptions shall be specified on the load line certificate together with the Convention authority which authorizes such exemptions.

(d) A vessel given one or more exemptions under the provisions of paragraph (b)(2) or (b)(3) of this section will be issued a Load Line Exemption Certificate, using Form E1. This certificate

shall be in lieu of a regular load line certificate, and the vessel shall be considered as in compliance with applicable load line requirements.

(e) The Commandant may exempt from any of the requirements of this part a vessel that engages on a domestic voyage by sea or a voyage solely on the Great Lakes and embodies features of a novel kind, if the novel features and any additional safety measures required are described on the face of the issued certificate.

(f) A vessel that is not usually engaged on domestic voyages by sea or on voyages on the Great Lakes but that, in exceptional circumstances, is required to undertake a single such voyage between two specific ports is—

(1) Subject to 46 U.S.C. 5101–5116 and the applicable regulations of this subchapter; and

(2) Issued a single voyage load line authorization by the Commandant that states the conditions under which the voyage may be made and any additional safety measures required for a single voyage.

[CGFR 68–126, 34 FR 9011, June 5, 1969, as amended by CGD 73–49R, 38 FR 12289, May 10, 1973; CGD 76–080, 54 FR 36976, Sept. 6, 1989; USCG–1998–4442, 63 FR 52190, Sept. 30, 1998]

§ 42.03-35 U.S.-flag vessels and Canadian vessels navigating on sheltered waters of Puget Sound and contiguous west coast waters of United States and Canada.

(a) In a Treaty between the United States and Canada proclaimed on August 11, 1934, the respective Governments were satisfied of the sheltered nature of certain waters of the west coast of North America. It was agreed to exempt vessels of the United States and Canadian vessels from load line requirements when such vessels engage on international voyages originating on, wholly confined to, and terminating on such waters. In Article I of this Treaty these waters are described as follows: “* * * the waters of Puget Sound, the waters lying between Vancouver Island and the mainland, and east of a line from a point 1 nautical mile west of the city limits of Port Angeles in the State of Washington to Race Rocks on Vancouver Island, and of a line from Hope Island, British Columbia, to Cape Calvert, Calvert Island, British Columbia, the waters east of a line from Cape Calvert to Duke Point on Duke Island, and the waters north of Duke Island and east of Prince of Wales Island, Baranof Island, and Chicagof Island, the waters of Peril, Neva, and Olga Straits to Sitka, and the waters east of a line from Port Althorp of Chicagof Island to Cape Spencer, Alaska, are sheltered waters * * *.”

(b) U.S.-flag vessels and Canadian vessels navigating on the treaty waters on a voyage as described in paragraph (a) of this section are by virtue of this Treaty of August 11, 1934, not subject to load line requirements in 46 U.S.C. 5101–5116, the 1966 Convention, and the regulations in this subchapter. Vessels navigating these sheltered waters and passing outside their boundary on any voyage cannot claim the benefits of this Treaty and shall be in compliance with the applicable load line requirements in 46 U.S.C. 5101–5116, the 1966 Convention, and the regulations in this subchapter.

(c) Since subdivision requirements apply to all passenger vessels subject to the 1960 International Convention on Safety of Life at Sea, those passenger vessels navigating on the waters described in paragraph (a) of this section shall be in compliance with such 1960 Convention requirements and the regulations in part 46 of this subchapter. The Coast Guard issues to such a vessel a stability letter. The assigning authority is authorized to issue to such a passenger vessel an appropriate load line certificate, modified to meet the conditions governing her service assignment, and marking.

[CGFR 68–60, 33 FR 10051, July 12, 1968, as amended by CGFR 68–126, 34 FR 9011, June 5, 1969; USCG–1998–4442, 63 FR 52190, Sept. 30, 1998]

Appendix C: Background Information on the “Big Four”

Donjon-SMIT LLC.

Upon the implementation of the new regulations for the SMFCs, the two companies Donjon and SMIT combined in an effort to meet the new requirements (Donjon-SMIT, 2011h). Donjon-SMIT is an expansive maritime salvage, firefighting and lightering service company, based not only in the United States but around the entire world. Along with Donjon-SMIT’s numerous years of participation in the marine emergency response profession, they provide a wide variety of services including:

- Stand-by coverage for marine salvage
- Firefighting and lightering
- Environmental care
- Damage stability calculations
- Drills and exercises

Marine Salvage is one of the largest divisions in the company, comprised of teams with the mission to engineer a solution for any situation (Donjon-SMIT, 2011g). Dealing in fire-fighting, naval architecture, hazardous chemicals, towage, marine pollution prevention, specialist diving, heavy-lifting engineering, and pumping, all aspects of a marine emergency are taken into account. Donjon-SMIT will respond 24-hours a day, anywhere in the U.S. waterways, including major rivers, and is compliant with all federal and state regulations.

Additionally, Donjon-SMIT (2011c) strives to prevent and contain oil and chemical spills. Techniques such as hot-tap technologies are used to extract contaminants, spill-free, from cargo holds and bunkers whether they are on or under the surface of the water. Using their own damage stability calculations, while on route to the distressed vessel, Donjon-SMIT (2011b) will calculate what necessary steps must be followed to provide safety for both the environment and the ship/crew members, while still maintaining an efficient work ethic.

Donjon-SMIT (2011a) also offers the use of a compliance decision tool. This tool incorporates their own engineer’s programming with that of Google Earth to provide a number of services, such as real time tracking of response vessels responding to any situation on in-land waters, coastal ways, 12 nautical miles (NM) off the coast, and or even up to 50 NM offshore. For many ships contracting with Donjon-SMIT, this tool ensures reliability, and the company’s capabilities to carry out a quick and effective emergency marine response. Below is a map of the world showing every marine casualty site Donjon-SMIT has responded to: each icon contains additional history about the response mission.



Figure 15: Donjon-SMIT LLC Casualty Response (Donjon-SMIT LLC, 2010)

Marine Response Alliance

Marine Response Alliance (2011c) is a nationwide multi-organization comprised of several towing, lightering, salvage and marine firefighting companies. The alliance is the combination of:

- Crowley Maritime Corporation
- Titan Salvage (A Crowley Company)
- Marine Pollution Control
- Marine Hazard Response
- McAllister Towing

All aspects of emergency marine response are overseen and completed by experts in each field (Marine Response Alliance, 2011g). Through their many joint locations, at various Captain of the Port Zones across the United States (Marine Response Alliance, 2011a), Marine Response Alliance (2011c) shows their strength through “commitment to emergency response and environmental protection” (para 3). The joint efforts of all five companies, provides a unique flexibility among the companies in order to accomplish any and all emergency situations.



Figure 16: Marine Response Alliance Locations (Marine Response Alliance, 2011a, para #1)

The Crowley Maritime Corporation (2011c) is a very uniquely diversified marine response company, offering many more services than just emergency response. Along with most other marine response companies, they offer salvage and wreckage removal as well as towing and environmental hazard clean-up/containment; however, they also deal with fuel sales in Alaska, harbor assistance, tanker escorts, oil and hazardous chemical transportation/shipping, and vessel design. In relation to the Marine Response Alliance, however, only the emergency marine response and towing related services are incorporated within the whole conglomerate.

Since the 1960's, Crowley (2011e) has been towing barges, tankers, and even drilling platforms. Now because Crowley Marine Services is only a portion of the Marine Response Alliance, towing and transportation are their major contribution within the alliance; however, a sub-company of Crowley (2011d) specializes in marine salvage, wreck removal, and emergency response: this company is Titan Salvage.

Titan Salvage (2011a), the second of five companies within the Marine Response Alliance to be discussed, is an emergency marine response company that was founded in 1980 by David Parrot. Over the years they built their company through the addition of boats and clients, until 2005 when they were bought out by the Crowley Marine Corporation. They now run 7 days a week, 24 hours a day and will respond to any wreckage removal or towing job with their major stations being located in the U.S., England, and Singapore.

The quick response to emergency calls is one of the major goals that Titan Salvage (2011d) tries to achieve every day, and with the use of Crowley's (2011b) tugs, Titan Salvage (2011d) has plenty of resources to assist their response to any marine emergency. Since the Crowley Maritime Corporation and Titan Salvage handle most aspects of transportation and emergency response, Marine Pollution Control along with Marine Hazard Response are ready to respond to any firefighting and/or environmental clean-up challenge (Marine Response Alliance, 2011g).

Marine Pollution Control was founded in 1967 specializing in oil and/or hazardous waste remediation projects as well as emergency lightering and firefighting (Marine Response Alliance, 2011f). Since their beginning, they have developed and refined the methods of the high capacity pumping systems and now have 27 of these systems strategically placed around the world in 19 ports. Along with their pumps, Marine Response Alliance's deployment teams have buoy containment systems available to use, if response is quick enough, for spills of oil or biohazard/WMD contaminants. Additionally, they have developed pneumatic marine fenders to support vessels while undergoing lightering.

While Marine Pollution Control contains the leaks from disabled vessels, Marine Hazard Response handles any fires that begin because of these spills (Marine Response Alliance, 2011e). Being the combination of two companies, Wild Well Control, Inc., and Williams Fire and Hazard Control, Inc., the firefighting techniques and equipment are very specialized with a wide deployment of foam and dry chemical fire retardants that can be tailored to suit the needs of each unique situation. They also provide pre-staged packages with equipment ready to use to contain fires.

The final member of the Marine Response Alliance is McAllister Towing (2004). They only are located along the east coast, and have a fleet of 70 tugs and 12 barges that have provided emergency marine services for nearly 70 years. McAllister deals mainly with boat docking, harbor towing, and general towing/transport, leaving larger, open ocean assignments for Crowley and Titan to deal with.

Collectively, Marine Response Alliance (2011d) is a versatile organization comprised of extremely practiced and professional companies within their areas of expertise. They provide a wide range of services, though some of their services are limited in availability: due to the fact that some members' of the alliance have fewer locations around the globe.

Resolve Marine Group

Resolve Marine Group (2011a) is a worldwide conglomeration of multiple companies/divisions. These include Salvage and Fire, Marine Services, and Resolve Maritime Academy. While all of these divisions are important for the safety of vessels out on the water, we are specifically interested in the Salvage and Fire division of the company. Within the Salvage and Fire division of the Marine Group, Resolve has three subsections which include marine salvage, marine firefighting, and a program that has been deemed "One Call" (Resolve Marine Group, 2011c). They provide a live call line that a vessel in distress can call at anytime, anywhere and they will respond to it and solve the situation. Also, they are, along with all 3 other service providers, "a U.S. Coast Guard, approved OPA-90 Primary Resource Provider" (Resolve Marine Group, 2011a, para 2).

In order to fulfill the duty of being a Primary Resource for the USCG, Resolve Marine Group (2011d) partnered with National Response Corporation and created the “One Call” program. This program was created after the passage of the Oil Pollution Act of 1990 (OPA-90), and since its creation they have been named as providers in many vessel response plans (VRP). The one call program provides environmental protection/clean-up services including oil and chemical spills. In Figure 17, one can view the area the one call program covers within the United States and its territories.



Figure 17: Resolve “One Call” Coverage of the United States (Resolve Marine Group, 2011d, para 1)

Along with providing the one call program, Resolve also provides normal salvage and wreck removal, that is to say, salvage and wreck removal that does not include a chemical or oil spill (Resolve Marine Group, 2011f). This division includes emergency response (salvage, fire, diving), wreck removal, emergency lightering, emergency towing, damage stability assessments, and post casualty environmental remediation.

They also offer a marine firefighting division, which not only includes professional firefighters, but salvage engineers and divers as well (Resolve Marine Group, 2011b). This division responds to emergencies on both chemical and oil tankers throughout the world. Along with shipboard firefighting, Resolve also offers the following services: Cause Investigation, Fire and Hazard Mitigation, and Firefighting Vessel Response Plan Assistance.

T&T Bisso

T&T Bisso owns a multitude of salvage systems ranging from inert gas generators to diving systems, all of which are transportable by air. T&T Bisso is a large company that was formed by the combined efforts of T&T Marine Salvage, which was founded in 1957, and Bisso Marine Company, which was founded in 1890. Together they formed T&T Bisso, which is its own company and is designed to respond to emergency situations in the maritime environment. Within this company, there are over 600 employees, many of whom are experts in their fields and well-known throughout the world. Figure 18 below illustrates the coverage provided by T&T Bisso.



Figure 18: T&T Bisso Worldwide Coverage (T&T Bisso, 2010f, para 1)

Since T&T Bisso (2010e) is a worldwide corporation, they must provide a multitude of services. Some of these services are ship to ship transfers, firefighting response, hazmat and pollution response, and wreck removal. In order to provide all of these services and more, T&T Bisso (2010b) has a large variety of craft and support equipment including: emergency towing vessels, crane barges, offshore supply vessels, and dive support vessels. Along with all of these crafts, T&T Bisso also owns and operates eight remotely operated vehicles and a multitude of supporting equipment.

T&T Bisso (2010a) is considered a leader in marine salvage, and is focused on offshore, or what they call “blue water” locations. Their mission follows these five rules of “Zero Discharge! Total Recovery! Total Stop Work Authority! No Failures to Communicate! No Shortcuts!”(para 1).

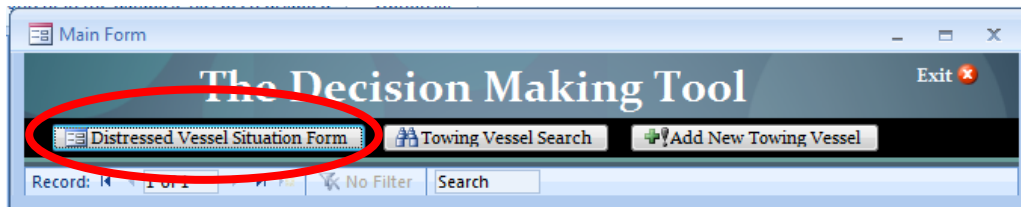
Another crucial service T&T Bisso (2010c) provides is hazmat and pollution response. What makes T&T Bisso unique in this category is that they will not only respond to marine-based pollution accidents, but they are also prepared to solve land-based pollution accidents as

well. T&T Bisso is capable of clean-up services not only for oil spills, but also hazardous materials. They are able to do this by maintaining a wide variety of clean-up equipment, some of which includes sorbents, vacuum units, skimming vessels, and containment booms.

Appendix D: User Manual for Decision Making Tool

Hello and welcome to the user's manual for the United States Coast Guard (USCG) decision making tool. This tool is meant to be as user friendly as possible and will guide you through choosing an appropriate emergency response vessel. In order to begin using the tool, click and open the icon labeled decision making tool in Microsoft Access. Once the tool is open, follow the steps below in order to verify that the choice of tug is correct for the job at hand.

1. When you open the program, a switch board will appear, to run the decision making program, click on the "Distressed Vessel Situation Form" button to begin.



2. As you can now see in the form in front of you, there are multiple fields which need to be completed in order to run the program.
3. Here is a list of all of the fields that must manually be filled in and a brief description of each:
 - a. Distressed Vessel – This is where the user enters the name of the ship currently in duress and need of aid
 - b. Length Overall (ft) – also LOA, Stands for the overall length of the ship; units are in feet
 - c. Breadth (ft) – Stands for the measure of the ships breadth, or width; units are in feet
 - d. Draft (ft) – Stands for the depth of a loaded vessel in the water measured from the level of the waterline to the lowest point of the hull; units are in feet
 - e. Height (ft) – Stands for the height of the ship measured from the bottom most point of the hull to the top of the superstructure; units are in feet
 - f. Deadweight Tonnage (Metric tons) – The measure of how much weight a ship can carry safely (includes weights of cargo, fuel, passengers, etc.); units are in tons
 - g. Distance (NM) – The total distance from the shore that the incident has taken place (tugboats that cannot travel that far from shore will be filtered out of the results); units are in nautical miles

Distressed Vessel Situation Input

Vessel

Clear Form Return

Distressed Vessel:	<input type="text"/>	←
Classification:	<input type="text"/>	
Contracted SMFF:	<input checked="" type="checkbox"/> All SMFFs <input type="text"/>	?
Distress Distance:	<input type="text"/> NM	← ?

Vessel Dimensions

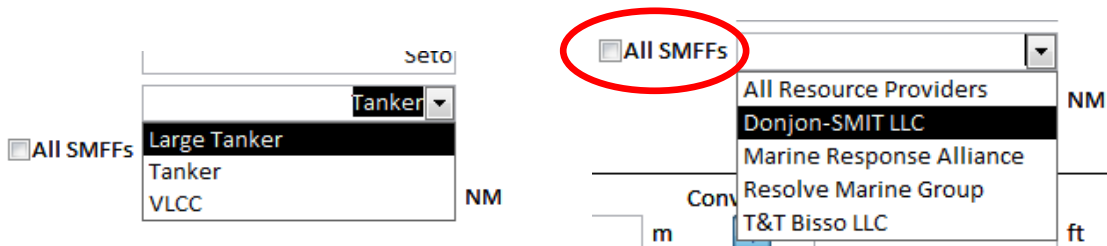
	Conversion		
Length Over All:	<input type="text"/> m	<input type="button" value="→"/>	<input type="text"/> ft ← ?
Breadth:	<input type="text"/> m	<input type="button" value="→"/>	<input type="text"/> ft ← ?
Draft:	<input type="text"/> m	<input type="button" value="→"/>	<input type="text"/> ft ← ?
Height:	<input type="text"/> m	<input type="button" value="→"/>	<input type="text"/> ft ← ?
Deadweight Tonnage:	<input type="text"/> Metric tons	<input type="button" value="→"/>	<input type="text"/> Short tons ← ?

Weather Conditions

Heading Relative to Wind:	<input type="text"/>	?
Beaufort Scale:	<input type="text"/>	?

***It is important to note that these descriptions are also available for viewing in the program. Simply hover the cursor over the question mark bubble (?) which is located to the right of the input fields.**

- Classification and Contracted SMFF (Salvage and Marine Firefighting resource providers) are in the dropdown list that provides the user with multiple options to choose from. Classification provides choices to name the type of vessel in distress, such as tanker, large tanker, and VLCC (very large crude carrier). Contracted SMFF provides the choice of resource provider the vessel should be contracted with in their Vessel Response Plan. This list consists of Donjon-SMIT LLC, Marine Response Alliance, Resolve Marine Group, and T&T Bisso LLC. Contracted SMFF also has a checkbox located to the left of the dropdown box. This box, if checked, will display all towing vessels in the output form, regardless of SMFF Resource provider.



5. Note that all the units for LOA, Breadth, Draft, and Height are needed in feet and Deadweight Tonnage is needed in short tons. If the user has these dimensions available in meters or metric tons, enter them in the box to the left and hit the arrow to automatically convert them.

	LOA in meters	Conversion	LOA now in feet	
Length Over All:	<input type="text" value="94.8"/>	m <input type="button" value="→"/>	<input type="text" value="311.0"/>	ft <input type="button" value="↻"/>
Breadth:	<input type="text"/>	m <input type="button" value="→"/>	<input type="text"/>	ft <input type="button" value="↻"/>
Draft:	<input type="text"/>	m <input type="button" value="→"/>	<input type="text"/>	ft <input type="button" value="↻"/>
Height:	<input type="text"/>	m <input type="button" value="→"/>	<input type="text"/>	ft <input type="button" value="↻"/>
Deadweight Tonnage:	<input type="text"/>	Metric tons <input type="button" value="→"/>	<input type="text"/>	Short tons <input type="button" value="↻"/>

6. Classification, Heading Relative to Wind, and the Beaufort Scale are drop down lists that the user may choose from in accordance to a specific situation. From selecting a value in these dropdown lists, a factor relating to that selection is inputted into the program calculations. Examples of the tables are listed below.
 - a. The wind drag coefficient, obtained from the “Classification” dropdown, is a multiplying factor that varies upon the classification of the vessel. Since large tankers and VLCCs are the same as a tanker (where the only difference is size), they share an average wind drag coefficient of 1.2.
 - b. The block coefficient is the percentage volume of the hull that occupies a cubic unit area. It is a multiplying factor, obtained from the “Classification” dropdown, that varies upon the hull shape of a vessel. For tankers, large tankers, and VLCCs, the average block coefficients are respectively 0.757, 0.802, and 0.842.
 - c. The heading coefficient, obtained from the “Heading Relative to Wind” dropdown, is a multiplying factor that varies upon where the wind is blowing in relation to the direction in which the vessel is being towed. If the wind is dead ahead, the coefficient is 1, if it is 15 to 45 degrees off dead ahead, the coefficient is 1.2, and if it is from 45 to 90 degrees, the coefficient is 0.4.

Classification:

Tanker ▼
 Large Tanker
 Tanker
 VLCC

NM

Beaufort Scale:

Scale	Description	Wind Speed	Wave Swell
0	Calm	0	0
1	Light Air	1-2 kt	0-1 ft
2	Light Breeze	3-6 kt	1-2 ft
3	Gentle Breeze	7-10 kt	2-3.5 ft
4	Moderate Breeze	11-15 kt	3.5-6 ft
5	Fresh Breeze	16-20 kt	6-9 ft
6	Strong Breeze	21-26 kt	9-13 ft
7	Light Gale	27-33 kt	13-18 ft
8	Gale	34-40 kt	18-25 ft

Heading Relative to Wind:

15-45 Deg Off Bow ▼
 Description
 15-45 Deg Off Bow
 45-90 Deg Off Bow
 Head On

- If this information is not readily available, it may be looked up in MISLE or another similar database, or it may be acquired from the distressed ship.
- Once all of the fields have been completed, click the Run Program button.

Distressed Vessel Situation Input

Vessel Clear Form Return

Distressed Vessel:

Classification:

Contracted SMFF: All SMFFs

Distress Distance: NM

Vessel Dimensions

Length Over All: m ft

Breadth: m ft

Draft: m ft

Height: m ft

Deadweight Tonnage: Metric tons Short tons

Weather Conditions

Heading Relative to Wind:

Beaufort Scale:

9. An output form will now appear in front of you with a long color-coded list of green, yellow, and red.
 - a) Green – Means that the tug not only has the Bollard Pull required for the ideal conditions, but also has the Bollard Pull required for the job once all of the resistances such as wind have been accounted for. Also, these tugs are able to travel out to the location of the incident. The tugs listed in this color are the best fit for the towing job and will not have a problem completing the task.
 - b) Yellow – Means that the tug has the Bollard Pull required for ideal conditions, and does not meet the Bollard Pull for the actual conditions. These tugs will most likely not be able to complete the task unless assisted by another tug.
 - c) Red – Means that the tug does not meet any of the conditions and is not suited for the job, or that they are harbor tugs and will not be able to handle the conditions out at sea. These tugs will not be able to complete the task at all.

Qualified Tug List

For Distress Situations

SMFF Resource Provider: **All**

Green = Meets All Conditions
Yellow = Meets Ideal Weather Conditions
Red = Not Suitable
Print Report
Return

Vessel	SMFF Resource Provider	Company	Contact	BHP	Bollard Pull	Ideal Weather B	Actual BP Needed
DELTA BILLIE	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	6800	133	69	70
DELTA CATHRYN	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	6800	133	69	70
DELTA DEANNA	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	4400	94	69	70
DELTA LINDA	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	4400	94	69	70
GOLIAH	TT Bisso LLC	Crowley Marine Services	(510) 251-7500	4400	94	69	70
Lynn Marie	Marine Response Alliance, TT Bisso LLC	Foss Maritime	(510) 307-7820	6250	85	69	70
NATOMA	TT Bisso LLC	Sause Bros INC	(562) 901-0365	5700	75	69	70
NAVAJO	TT Bisso LLC	Sause Bros INC	(562) 901-0365	5700	75	69	70
PACIFIC FREEDOM	TT Bisso LLC	K-Sea Transportation	(206) 443-9418	4400	70	69	70
NAKOLO	TT Bisso LLC	K-Sea Transportation	(206) 443-9418	5750	69	69	70
COCHISE	TT Bisso LLC	Sause Bros INC	(562) 901-0365	3750	65	69	70
MIKIONA	TT Bisso LLC	Sause Bros INC	(562) 901-0365	3750	65	69	70
Millennium Star	Donjon-SMIT LLC	Harley Marine	(510) 666-5010	4400	64	69	70

a) { DELTA BILLIE, DELTA CATHRYN, DELTA DEANNA, DELTA LINDA, GOLIAH, Lynn Marie, NATOMA, NAVAJO

b) { PACIFIC FREEDOM, NAKOLO

c) { COCHISE, MIKIONA, Millennium Star

10. A description of all of the columns within this list can be seen below:
 - a. Vessel – The name of the tug
 - b. Company – Company which has contracted with this tug, or in some instances owns this tug
 - c. BHP – Brake horsepower in Horse Power
 - d. Bollard Pull – The Bollard Pull of the tug in short tons
 - e. Ideal Bollard Pull – The minimum Bollard Pull required to tow the distressed vessel in ideal weather conditions.

- f. Actual Bollard Pull – The minimum Bollard Pull required to tow the distressed vessel, with weather resistances taken into consideration.
- g. Distress Distance – The location of the vessel in distress in relation to distance from shore.
- h. Purpose – The purpose of the tug, meaning it is either a harbor, coastal or ocean going tug

11. The user then can print a report of the output form by clicking “Print Report” located at the top of the form.



A sample report is shown below.

Wednesday, December 07, 2011
10:04:57 AM

Qualified Tug List For Distress Situations

SMFF Resource Provider: **All**

Green = Meets All Conditions Yellow = Meets Ideal Weather Conditions Red = Not Suitable

Towing Vessel Name	SMFF Resource Provider(s)	Company	Company Contact Number	Break HP	Vessel Bollard Pull	Ideal Weather BP	Actual BP Needed	Distress Distance (NM)	Vessel Type
DELTA BILLIE	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	6800	133	69	70	40	Ocean
DELTA CATHRYN	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	6800	133	69	70	40	Ocean
DELTA DEANNA	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	4400	94	69	70	40	Ocean
DELTA LINDA	TT Bisso LLC	Baydelta Maritime	(415) 693-5800	4400	94	69	70	40	Ocean
GOLIAH	TT Bisso LLC	Crowley Marine	(510) 251-7500	4400	94	69	70	40	Ocean
Lynn Marie	Marine Response Alliance, TT Bisso LLC	Foss Maritime	(510) 307-7820	6250	85	69	70	40	Ocean
NATOMA	TT Bisso LLC	Sause Bros INC	(562) 901-0365	5700	75	69	70	40	Ocean
NAVAJO	TT Bisso LLC	Sause Bros INC	(562) 901-0365	5700	75	69	70	40	Ocean
PACIFIC FREEDOM	TT Bisso LLC	K-Sea Transportation	(206) 443-9418	4400	70	69	70	40	Ocean
NAKOLO	TT Bisso LLC	K-Sea Transportation	(206) 443-9418	5750	69	69	70	40	Ocean
COCHISE	TT Bisso LLC	Sause Bros INC	(562) 901-0365	3750	65	69	70	40	Ocean

12. Going back to point 3, when the checkbox is not selected, the user can choose which SMFF resource provider to sort the form “Qualified Tug List” above. In this case, the form will be specific to the resource provider the towing vessels are contracted with for emergency response. If the user decides to receive confirmation on the location of a tug and its availability during the given situation, contact information for the provider is available at the top of the form, as illustrated below. The Validation e-mail link fills in the recipient and subject of a blank e-mail, and automatically prints the report to a pdf file which is attached.

Qualified Tug List
For Distress Situations

SMFF Resource Provider: **T&T Bisso LLC**
(713) 534-0700

[Send Validation Email](#)

Green = Meets all Conditions Yellow = Meets Ideal Weather Conditions Red = Not Suitable

[Print Report](#) [Return](#)

13. Once a tug has been chosen and verified, the user may click the tugboats name in the Vessel column, which will then immediately direct them to a specifications sheet with all of that tugboat’s information, as seen below.

Vessel	SMFF Resource Provider	Company	Contact	BHP	Bollard Pull	Ideal W
DELTA BILLIE	T&T Bisso LLC	Baydelta Maritime	(415) 693-5800	6800	133	69
DELTA CATHRYN	T&T Bisso LLC	Baydelta Maritime	(415) 693-5800	6800	133	69
DELTA DEANNA	T&T Bisso LLC	Baydelta Maritime	(415) 693-5800	4400	94	69
DELTA LINDA	T&T Bisso LLC	Baydelta Maritime	(415) 693-5800	4400	94	69
GOLIAH	T&T Bisso LLC	Crowley Marine Services	(510) 251-7500	4400	94	69
Lynn Marie	Marine Response Alliance, T&T Bisso LLC	Foss Maritime	(510) 307-7820	6250	85	69
NATOMA	T&T Bisso LLC	Sause Bros INC	(562) 901-0365	5700	75	69
NAVAJO	T&T Bisso LLC	Sause Bros INC	(562) 901-0365	5700	75	69
PACIFIC FREEDOM	T&T Bisso LLC	K-Sea Transportation	(206) 443-9418	4400	70	69
NAKOLO	T&T Bisso LLC	K-Sea Transportation	(206) 443-9418	5750	69	69



Tug Specifications

VIN:	1078815	
Vessel:	DELTA LINDA	
SMFF:	TT Bisso LLC	
Company:	Baydelta Maritime	
Contact:	(415) 693-5800	
LOA:	105	ft
Breadth:	36	ft
Draft:	15	ft
BHP:	4400	HP
Bollard Pull:	94	Short Tons
TugBoat Purpose:	Ocean	

Save

Return

14. At any point throughout using the database the user can hit the return button, located on every form, to be directed back to the previous form(s) to change any information that was initially filled in.

Qualified Tug List
For Distress Situations

SMFF Resource Provider: **TT Bisso LLC**
(713) 534-0700

Send Validation Email

Green = Meets all Conditions Yellow = Meets Ideal Weather Conditions Red = Not Suitable

Print Report **Return**



15. The program may also be used to search for information on any tug in the database. To do this, click the “Towing Vessel Search” button on the main form, select the tug by the name or VIN number in the first dropdown box, and hit the “Search” button located next to box.

Specific Tow Vessel Search

Return

Select a tug

Vessel Name:

Looking for specific name of the tug

Resource Provider

Looking for tug of the Resource Provider

Adriatic Sea	7716969
ALTAIR	8115980
AMERICA	1206415
AMERICAN EAGLE	7032416
AMERICAN PATRIOT	7113882
BEARCAT	7618167
BISMARK SEA	7512052
BLACK HAWK	67021962
CABRILLO	262816
CAPT. LES EASOM	7129520
CHINOOK	7129817
COCHISE	9415595
DELTA BILLIE	1218585
DELTA CATHRYN	272680
DELTA DEANNA	1078814
DELTA LINDA	1078815

Search

Search

The resulting form:

Tug Specifications

Save

Return

VIN:

Vessel:

SMFF:

Company:

Contact:

LOA: ft

Breadth: ft

Draft: ft

BHP: HP

Bollard Pull: Short Tons

TugBoat Purpose:

16. From the tugboat search form, the user can also look up all the tugs contracted under a single SMFF resource provider. To do this, simply select the provider wanted in the second dropdown box and click the “Search” button next to it. From this window you can also click on the tug’s VIN number to pull up the specifications sheet above.

Select SMFF

Resource Provider:

Looking for tugs from a certain of the Resource Provider and

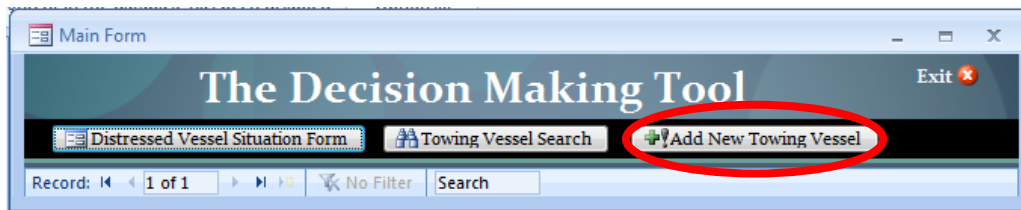
Search

TT Bisso LLC
Donjon-SMIT LLC
Marine Response Alliance
Resolve Marine Group
TT Bisso LLC

The resulting form:

SMFF Tug List									
Resource Provider:		TT Bisso LLC			Return				
VIN	Company	Vessel	LOA	Breadth	Draft	BHP	Bollard Pull	TugBoat Pur	
7716969	K-Sea Transportation	Adriatic Sea	118.7	34	13.6	4800	58	Coastal	
8115980	K-Sea Transportation	ALTAIR	98.4	33.5	14.8	3800	46	Coastal	
1206415	Foss Maritime	AMERICA	91.5	40	14.9	6610	79	Coastal	
7115882	American Marine Corp	AMERICAN PATRIOT	109.5	34.1	16.5	4100	62	Coastal	
7512052	K-Sea Transportation	BISMARCK SEA	136	36.5	17.5	6000	72	Coastal	
7033382		BLACK HAWK	122	34	14.9	3000	30		
262816		CABRILLO	42.3	14	6	340	3		
7129520	Sause Bros INC	CAPT. LES EASOM	123.6	31	12.4	3900	63	Ocean	
7129817	Sause Bros INC	CHINOOK	133.2	34	15.7	3900	58	Ocean	
9415595	Sause Bros INC	COCHISE	128.3	34	14.7	3750	65	Ocean	
1218585	Baydelta Maritime	DELTA BILLIE	100	40	13.78	6800	133	Ocean	
272680	Baydelta Maritime	DELTA CATHRYN	100	40	13.8	6800	133	Ocean	
1078814	Baydelta Maritime	DELTA DEANNA	105	34	13.6	4400	94	Ocean	
1078815	Baydelta Maritime	DELTA LINDA	105	36	15	4400	94	Ocean	
1228451	Baydelta Maritime	DELTA LINDSEY	93			1800	9	Coastal	
7626217	Foss Maritime	DREW FOSS	118.7	34	12.1	3000	32	Ocean	
7802641	K-Sea Transportation	EL LOBO GRANDE II	128.6	36.6	16.1	5750	69	Coastal	
540227	Dunlap Towing	Gene Dunlap	123.6	30	15	3420	34	Ocean	
1060909	Crowley Marine Services	GOLIAH	105	36	13.4	4400	94	Ocean	
7530078	Sause Bros INC	HENRY SAUSE	99.4	26	13.7	3900	53	Ocean	
1037412	Dunlap Towing	James Dunlap	100.9	36	17.1	4300	54	Ocean	
6407834	K-Sea Transportation	JOHN BRIX	141	35	17.6	3900	47	Ocean	
7402726	Sause Bros INC	JOSEPH SAUSE	94.8	29	15.8	3900	53	Coastal	
7512002	Foss Maritime	JUSTINE FOSS	118.7	34	12.1	4300	54	Ocean	
7644271	Sause Bros INC	KLIHYAM	120	34	16.9	3900	6	Ocean	
6516934	Sause Bros INC	KOKUA	125	31.5	14.2	4000	58	Ocean	
7614082	Dunlap Towing	Malolo	100.9	31	13.5	3420	34	Ocean	
506243	Dunlap Towing	Manfred Nystrom	121.1	32.3	8.6	3900	39	Ocean	
566082	Dunlap Towing	Mike O'Leary	100.2	31.2	8.8	4000	40	Ocean	
7031163	Sause Bros INC	MIKI HANA	106.3	30.1	12.5	5700	30	Ocean	

17. To add a new tug to the database, simply click add towing vessel in the main form, as seen below.



18. From there simply fill out all specification fields within the form.

Tug Specifications

 Save  Return

VIN:

Vessel:

SMFF:

Company:

Contact:

LOA: ft

Breadth: ft

Draft: ft

BHP: HP

Bollard Pull: Short Tons

TugBoat Purpose:

19. Then click save to save the tug within the database. It is now available in the system and will show up in the output form.

Appendix E: Interview Protocols

LT Andrew Lawrence – Salvage Engineering Response Team

October 25, 2001

Interview Protocol:

- What is a load line?
- What are good characteristics to catalog tugs by?
- How could we determine if a tug can go offshore?
- How could we determine if a tug can pull the desired load?

Interview Summary:

- Need to answer two questions
 - o Can the tug go offshore?
 - o Can the tug pull the load?
- Load line
 - o Physical line painted on the hull of a ship
 - o Marks the legal limit to which a ship may be loaded
 - o To have a load line a ship must meet two requirements:
 - Be over 79 ft long
 - Travel at least 20 miles offshore
 - o Therefore, if a ship has a load line, it can travel offshore
- Stability
 - o Regulatory stability determines if a ship can go offshore
 - o Graphs of a ship heeling
 - Degrees vs Moment (feet)
 - Slope of initial line is Metacentric height (GM)
 - Points that intersect zero
 - Points of stability
 - Ship is stable if graph is still positive at 60 degrees
 - Area under curve to 40 degrees must be 17 feet*degrees to go offshore
 - o Hull shapes also impact stability
- Stability Characteristics
 - o Try to find ways characteristics relate
 - o Get tug dimensions and graph GM and righting arm
 - Look for any correlation
- Bollard Pull
 - o Important to know if the tug will physically be able to handle the load

- Important Regulations
 - 46 CFR 174
 - Requirements for tugs
 - 46 CFR 173.090 towline pull
 - Subpart (e) relates bollard pull to stability
- Bourbon Dolphin Accident Simulation
 - Sometimes the crew is not qualified
 - Can lead to accidents

Matt Hahne – Resolve Marine Group

October 27th, 2011

Interview Protocol :

- What characteristics do you currently classify your emergency response vessels by?
- Do you feel like this is adequate? Why/why not?
- What characteristics do you think you could add to classify your response vessels in a more efficient fashion?
- What specifications do you feel are primarily necessary for a tug to have in order to be considered an offshore tug?
- What do you use Marine Exchange for and why do you not just use AIS for everything?
- What is essential to know in order to determine if the chosen response vessel will be able to pull the desired load?

Interview Summary:

- Tugs are classified by several factors; ability to work in operable environment, which includes offshore waters or shallow waters, the weather, currents/conditions of the sea, bollard pull and location (most important).
- Integrated tugs and barges (ITB) are important to consider which tugs are good, because some big harbor tugs are able to go offshore, but that does not mean they are going to. Sometimes tugs are sent to do jobs even though they are not necessarily built to do those jobs but are closer to the incident and are capable so they get pulled into work.
 - An example would be the big harbor tugs going offshore, while they are meant to be in harbors more; sometimes they are used for towing if nothing else is available in the area.
- The process of sending out a tug is the problem they are faced with.
 - Begins with checking which tugs are closest (location).
 - Call dispatchers to see which tugs are not preoccupied with other contracts.
 - Of the ones available and the ones that are preoccupied, they are separated into how much they can pull. If the contracted tug is preoccupied, they can have another tug with similar capabilities fulfill the contract with the distressed ship.
 - More often than not jobs require multiple tugs in order solve the situation.
- Problem that occurs with the proposed system on the practical side of the matter is that the towing environment is very dynamic and is hard to have a single standard for every situation, because the situations differ extremely from call to call.

-With the big company contracts they double check the tug locations and availability through AIS and Marine Exchange and also through talking with the tug dispatcher.

- Marine Exchange is used in order to fill the gaps in AIS, because AIS does not always contain all of the necessary characteristics of each tug.

-Bollard pull/horsepower requirements is difficult to generalize also because of the differences in each emergency situation.

- There is no simple calculation for the bollard pull necessary for the job at hand, it depends on several factors; intuitiveness of the salvor, how badly the ship is grounded, where on the ship the grounding has occurred, the size and dimensions of the ship, whether it is low/high tide, the weather conditions and the geographic location.

Jonathan Mendes- Towing Vessel Working Group

October 28, 2011

Interview Protocol:

- Patricia Adams has provided us with a brief overview of what you do. Can you elaborate or explain to us what you do?
- Explain and provide a brief overview on what we are planning on doing. How do you feel about this concept?

- Do you think it will be useful?

- Do you have any suggestions that you think would be useful for this tool to be used in your port?

- What information do the COTPs generally have on the tugs in the San Francisco Port?

- Do you believe that there is enough information on them for the ports to utilize? ...to define an “adequate” tug?

- What are the general types/sizes of the tankers, cargo ships, and barges that come into your port?

Interview Summary:

- Biography
 - o Worked as deck hand out of high school
 - o Career as tug captain
 - o 15 years experience in towing
 - o Manages fleet on west coast
 - Contracted under Resolve Marine
 - Of 20 tugs, 5 are offshore capable
 - 85% of business is ship assist
 - o Part of San Francisco Harbor Safety Committee
- San Francisco Harbor Safety Committee
 - o Promote safety of maritime transportation on San Francisco Bay
 - o Last met in June
 - o Scheduled to meet 2nd or 3rd week of November
- His study
 - o Research tug capabilities
 - o Identify characteristics for salvage
 - Suitable for salvage
 - Suitable for firefighting
 - o Current Project
 - Flat tow bollard pull study

- Horsepower matching for flat tows in the San Francisco Bay
- Tugs
 - Millennium Tugs
 - 5500 horsepower
 - \$12 million to get floating
 - Five year plan to pay off
 - All purpose
 - Harbor and offshore
 - Location
 - Two in the San Francisco Port
 - Two in the Las Angelis Port
 - December 2009- River Elegance Rescue
 - Left San Francisco in 28 ft seas
 - Performed rescue in constant 15 ft seas
 - Two tugs towed container ship back at 5.5-6 knots
 - Tractor Tug
 - Two pods below tug
 - Can thrust tug in any direction
 - Can move 5-6 knots sideways
 - Moves almost as fast backwards as possible forwards
 - Turn sideways to create drag and slow ships
- Orville Hook
 - Retrieval Mechanism
 - Attaches directly to vessel anchor/anchor line
 - Used to tow in rough/dangerous conditions
- Pilots
 - Pilots not involved until sea buoy
 - Pilots guide tugs into port
 - Prevent tugs from engaging in unsafe operations
- Studies to look at
 - Oil Companies International Marine Forum (OCIMF)
 - Safe tug study
 - Safety guidelines
 - Mooring equipment Guidelines (MEG 3)
 - Cover minimum recommended OCIMF mooring guidelines

Jerry Bynum Conference Call

October 31, 2011

Interview Protocol:

-Patricia Adams has provided us with a brief overview of what you do. Can you elaborate or explain to us what you do?

-Explain and provide a brief overview on what we are planning on doing. How do you feel about this concept?

-Do you think it will be useful?

-Do you have any suggestions that you think would be useful for this tool to be used in your port?

-What information do the COTPs generally have on the tugs in the San Francisco Port?

-Do you believe that there is enough information on them for the ports to utilize? ...to define an "adequate" tug?

Interview Summary:

- Gave Jerry a brief overview of our project and where we hope to take it
- Asked about the work he was doing in the San Francisco Port area classifying tugs
 - Working with Captain Jonathan Mendes
 - Learning process as they go
- Proposed spreadsheet
 - Left side starts: Company Name, Tugboat Name, Tug Location, Tugboat Type(Ocean, Harbor, River)
 - To Right: LOA, Breadth, Draft, BHP, Bollard Pull (Ahead/Astern), Anchor (Y/N)
 - Continues: Tow/Bow Winch Gear (type drum and wire thickness)
- His spreadsheet also includes other specifications other than towing characteristics
 - Specified home port, knowledge of other ports visited
 - Tugs move – how to better understand ETA when sent out
 - Firefighting capabilities
 - Fire monitor (Y/N)
 - Type
 - GPM output
 - AFFF (Y/N)
 - Type

- GPM output
- Jerry inquired what is our proposed final result
 - Proposed recommendations on a better way to define adequate tugs
 - Our project and Jerry's project are similar in ways
 - Can greatly benefit and have national impact in the long run
- Both Jerry and our team here at USCG HQ will keep each other updated and informed of any progress

CDR James Rocco – Class Society Liaison

November 1, 2011

Interview Protocol:

- What are “Class Societies”?
- Can you explain Load Lines a little more in depth?
- Would Load Line Certificates be a good source to determine is a vessel is ocean-going?
- Would we be able to access the actual certificates?

Interview Summary:

- Biography
 - Graduated Central Michigan University
 - Psychology
 - Health Science
 - Later got an MBA in International Affairs
- Class Societies
 - Non-profit organization
 - Similar work as Coast Guard
 - Started so vessels and cargo can be insured at reasonable rates
 - Important to keep commerce side of maritime running
 - While Coast Guard is important for safety
 - The two work closely together
 - Over 170 classes around the world
 - 13 form the International Association for Class Societies (IACS)
 - Formed about 20 years ago
 - Most prestigious classes
 - American Bureau of Shipping (ABS) is the main one for America
 - Perform surveys
 - Equivalent to Coast Guard inspection
 - Save the Coast Guard time and effort
- As Class Liaison
 - Handle anything/everything with US vessel and class
 - Middleman between class societies and Coast Guard
 - Called when a problem is encounter
 - Finds the problem from class society
 - Conveys problem to Coast Guard
- Load Lines
 - 79 feet or more, and offshore
 - Plimsoll mark
 - Steel white raised letters to tell who certified the Load Line

- Circle with a line through it
 - Load lines jet off from circle and end with a significant letter
 - Ending letter depicts what type of weather that load line is designed for
 - Line dictates how much you can load the ship
 - Lines are measured down from reference point usually right at the deck line
- Off-shore Vessels
 - Try looking at hull forms
 - Call shipyards and give specific dimensions
 - Ask for the hull form of those vessels and if they can go off-shore

MST 1 Christopher “Dean” Johnston

November 2, 2011

Interview Protocol:

How easy is Access to learn?

Would Access be a good tool to use for our project?

Can you give us a basic tutorial for Access?

Interview Summary:

- Access is based on parameters
 - o Get information in
 - Can import data
 - o Build a query
 - o Clean it up and reorganize
 - o Create form
 - o Add text fields
- Access is versatile
 - o Result showing one tug vs. all tugs color coded
- Hardest part is making it scenario based
 - o Hasn't done it before but not impossible
 - o “if you can think of it, you can do it”
 - o Back-up plan –printable paper report
- Don't need all data to start
 - o Only need to know specific fields
 - o Can input dummy data
- Think about including contact information for each tug
- Just play around in Access until you get exactly what you want

Jim “Doc” Ruth – Navy Supervisor of Salvage and Diving

November 7, 2011

Interview Protocol:

How do sea conditions e.g. wind/waves/currents and their resulting resistances effect tugboats during a towing operation?

Are there any/what are the equations relating sea conditions to forces acting against a tugboat?

What are the conditions/forces associated with 40 knot winds in particular?

Within our decision making tool, what range of bollard pulls do you believe would place a tug in the categories of green, yellow, red output?

What tugboat specifications do you consider when selecting a proper tugboat that we have neglected from our database?

Interview Summary:

- Background Information
 - o Technical authority for Navy Towing
 - o Currently re-writing the Navy Towing manual
 - Aligns with commercial towing relations and practices
- Important criteria to consider when towing-included in manual
 - o Wind coefficients
 - One of the largest factors of drag
 - o Ideal to calculate steady state towline conditions
 - o Propellers (screw) add drag
- The Navy Manual has many equations to calculate the all resistances
- When dealing with up to 40 knot winds
 - o Gail force conditions create many resisting forces
 - Hydrodynamic resistance
 - Towline resistance
 - Wind resistance
 - Sea state resistance
 - Scope
 - Catenary
- When in large swells
 - o Tug master must keep “in step” with the waves
 - Letting out wire and taking it back in
 - Adjusting speed
- All equations needed for resistances are in Navy Towing Manual Appendix G
 - o Online at www.supsalv.org
- Suggestion to look at other characteristics of tugboats
 - o Tow Line
 - Catenary-spring ability of wire
 - Material used
 - Nylon
 - Steel
 - Plasma
 - o Many ships now use plasma

- Connecting shackle
 - Need proper strength
 - Only forged steel, no spot welded steel
 - No nylon
 - Loses strength in water
 - Not made to hold over 600 tons pull usually
- Tanker connection (bat eye/connection spot)
 - Must check if it can handle the stresses
- ABS deck guide lines for specifications
 - Systems check
- Tow with winch
 - Many different methods
- To certify a tugs bollard pull
 - Only trust bollard pull certificate
- Navy focus for towing
 - Pull at 5 knots?
 - Pull in 5 foot waves?
- If tug is not U.S. classed
 - Check for reputable international class society
 - Det Norske Veritas (Norway)

Tom Gruber and Charles “Joey” Wheeler – American Bureau of Shipping (ABS)

November 7, 2011

Interview Protocol:

What is the protocol followed when determining if a vessel requires a load line and how does it meet the requirements if any?

What are the calculations, if any, used in calculating variables such as freeboard in relation to load line?

In relation to our project (decision making tool), what classification requirements does ABS look at when surveying a vessel e.g. bollard pull, size/dimensions?

Interview Summary:

- Background Information on Tom Gruber
 - o Located out of ABS in Alexandria
 - o With ABS 23 years
 - 21 years working with load lines
- Background Information on Charles Joey Wheeler
 - o Deals with other specifications bollard pull/ size requirements
- Load Line convention
 - o Began in 1956, revised 2003
 - Set maximum draft for a ship to operate at
 - Details how a ship operates out at sea
 - If it is weather/water tight
- 4 step practice
 - o First - Plan review for structural hull/superstructure drawings
 - o Second – Conditions and assessment review
 - o Third – Stability requirements
 - o Fourth – Minimum freeboard
- When doing freeboard calculation must look at draft, dimensions in relation to the freeboard chart
 - o When first used: based off a Series 60 hull form vessel
 - Now all calculations are done to size the vessel in relation to the chart

- Suggested to talk to Tom Jordan
 - Wrote tech manual for load lines
 - Has calculations for load lines
- Joey Wheeler deals with other characteristics of vessels
 - ABS has not requirements on many other specifications but looks at tow cables and winches
 - Review ABS OSV Guide (on eagle .org)
 - Part 5 Chapter 3
 - Tow requirements
 - Criteria - Take bollard pull and apply to towing gear
 - Calculate allowable stresses on the gears

Appendix F: Recommendation E-mails Received from Beta-testing

E-mail 1

-----Original Message-----

Sent: Tuesday, November 29, 2011 5:45 PM
To: Ismirlian, Ryan CTR

Subject: RE: - Student Project - CG-5431 Vessel Response Plan

Ryan,

Good afternoon. Took a quick look at this today - pretty neat little program! I'll be honest, I didn't review the calculations, I'm assuming someone has already picked them over for accuracy :)

With that being said, I thought your program was relatively user friendly. That being said I'll offer a couple suggestions which you might find useful:

- 1) Include some text boxes to explain the fill in boxes alongside the input boxes (this is often easier than opening a separate word document)
- 2) Include some text boxes to explain the tug details box at the top (what is it for?) I'm assuming it might be if you already know what tug is going to be provided and you are checking out it's details? (Maybe this should be a separate form).
- 3) A switchboard giving the user a list of available options might be useful
- 4) Add a legend right in the TUG QUALIFIED LIST output screen to explain the color coding
- 5) Height is actually going to be a hard value to obtain (it might not be a bad idea to provide some approximations for basic vessel types as default values in case the user does not have good info)
- 6) The same might be true of deadweight tonnage info (unless it has already been entered into MISLE), but vessel/salvor should be able to provide

Now onto some potential filtering options for consideration:

- 1) Is it possible to break the towing vessels down into COTP zones? Then the user could filter on towing vessel actually available and listed as being a towing vessel in their zone?
- 2) In addition to breaking up towing vessels by COTP, what about filtering on towing vessels by the contracted salvor? Each salvor has a list of approved towing vessels for different COTP zones. This would help the unit know if the salvor is actually using a tug that is listed in their plan, or if they are deviating. The "tug spec sheet" could also list what salvor and if it is approved for the COTP zone the user is in....
- 3) Is it possible to create a filter for inshore and offshore zones and then based on distance that tug is from vessel (if you are being provided with the tug info from the salvor, then they can tell you how far it actually is and what it's design speed is) and vessel tug speed (I don't see speed listed as a tug spec, but it might be available, or it could be an input) determine how long it would take vessel to arrive on scene to see if it falls within the planning timelines?

Appreciate the work ya'll have done on this!

Regards,

Lieutenant Commander, U.S. Coast Guard
Salvage Officer

E-mail 2

-----Original Message-----

Sent: Tuesday, November 29, 2011 7:56 PM

To: Ismirlian, Ryan CTR

Subject: RE: - Student Project - CG-5431 Vessel Response Plan

Good afternoon Ryan & other team members,

First of all, I appreciate the opportunity to review your work. I was excited to play with the Access program & could tell that a significant amount of hard work went in to its development. I ran through a series of real vessels of different sizes to test the program out. The tool appeared to function properly and outputted results as described in the User Manual.

I had the opportunity to read through Dan Cost's response from earlier this afternoon, and I concur with his ideas on how to make the program more user friendly & pertinent to different COTP zones. I don't have any further comments on the actual Access database program. However, I do want to point out a couple of issues that I noted with the equations listed in the "Database Equations" document:

1. The use of Deadweight Tonnage to calculate block coefficient is incorrect. "Block Coefficient" is the ratio of the immersed hull volume to that of a rectangular box of the same length, breadth, and draft as the ship. "Deadweight Tonnage" (correctly defined in your User Manual) is simply a measure of the ship's weight capacity of cargo, consumables, etc. You cannot calculate "Immersed Hull Volume" from Deadweight Tonnage. Converting Deadweight Tonnage to a volume of displaced water (DWT/0.03199) as you did in your formula does not equal the total immersed volume of the ship. Instead, to correctly calculate Block Coefficient, you would need to substitute Displacement (in tons) for Deadweight in your formula. In most cases, a vessel's deadweight is only 50-70% of total displacement, so your results are being substantially skewed using the current formula.

In order to correct this, you could do one of the following two options:

- a. Get displacement directly - either 1) actual displacement from the vessel in its distressed condition or 2) sometimes full load displacement is listed in MISLE under the Vessel Tonnage tab. In this case, the equations to calculate block coefficient and displacement wouldn't be needed.
 - b. If displacement is unknown, then you can use your Displacement calculation using an estimated value for Block Coefficient for the vessel type. The attached document (taken from the text "Marine Casualty Response") provides a good list of average Block Coefficient values for various commercial vessel types.
2. The "Frontal Area" calculation appears to be incorrect given your inputs in the program. You define "Height" as: "height of the ship measured from the water's edge on the hull (waterline) to the top of the superstructure." Frontal Area should then be "Height x Breadth" not "(Height-Draft) x Breadth" because the distance below the waterline (draft) is not included in your definition of "Height".
3. For the "Necessary Bollard Pull" calculation - I'm not familiar with that equation, so I can't really comment. Is this the same as "Ideal Bollard Pull" in the tool? I would be interested in seeing the source (or derivation) of that equation. Also, I'm not sure what formula was used for "Actual Bollard Pull". It wasn't on the database equation document. I assume it combines the resistance loads for the hull and wind (& an assumed sea state?) into one required bollard pull.
4. Be careful with units throughout! In the Displacement formula, the 35 in the denominator gives the displacement in Long Tons (2240 lbs). The Wind Resistance formula is in metric tons (2205 lbs). Bollard pull is typically given in short tons (2000 lbs). Perhaps these are already accounted for in your bollard pull formulas - I was just noting it as a precaution because I've made similar mistakes with units in the past.

Again, great work in developing this tool. I envision a number of applications where it could be particularly useful (i.e. review of Salvage Response Plans at HQ, verification of adequate tug bollard pull for transit plans in the field, SERT, etc.) I applaud your efforts and wish you the best of luck as you finish the project.

Please feel free to email or call if I can provide further clarification or any other assistance.

Best regards,

[Redacted]

[Redacted]

Commanding Officer
USCG Marine Safety Unit [Redacted]

[Redacted]

Appendix G: Glossary

- **Aft** – In naval terminology, meaning towards the stern of a ship
- **Barge** – A boat used for river and harbor transport
- **Beam** - The measured breadth of a ship
- **Bow** - The front end of a ship
- **Bridle** – A V-shaped connection made by the towlines attached between a tugboat and the vessel it is towing
- **Bollard Pull** – The force, measured in short tons, a tugboat can apply while pulling a load in ideal conditions
- **Deadweight Tonnage** – A ship's specific cargo capacity
- **Draft** – The depth of a ship's keel
- **Dumb Vessel** – A ship with a broken propulsion system
- **Freeboard** – The area of the side of the boat between the water's edge and the deck
- **Gross Tons** – The volume of space inside a ship measured where 100 cubic feet is equal to one ton
- **Harbor Boat** – A boat used in operations based within the harbor, assigned to do jobs such as docking, etc.
- **Home Port** – The port which the ship is registered to, and possibly the home of its captain/crew
- **Horsepower** – A measurement of power used primarily in engines: both designed for output such as driving or shaft force, or input such as breaking force
- **Hull** – The body of a ship
- **Keel** – The centerline of the ship, attached and runs along the bottom of the ship's structure
- **Lighter** – Primarily a barge used for harbor loading, unloading, or transport
- **Lightering** – The act of removing cargo from one ship, usually distressed, to another
- **Metacentric Height** – The initial stability of a ship
- **Nautical Mile (NM)** – Equivalent to 2000 yards
- **Official Number** – Marked on the main beam of a ship, assigned by the U.S. Maritime Administration to a U.S. documented vessel
- **Offshore Waters** – Waters which are commonly further than 12 miles from the coast
- **Port** – The left side of a ship; A harbor for ships
- **Propeller (Prop)** – A mechanical device with rotating blades, connected to a revolving, power-driven shaft used to move a ship. Also referred to as a screw
- **Stern** – The rear end of a ship
- **Skeg** – A fixed blade attached to the stern-most section of the keel acting as a fixed rudder
- **Starboard** – The right side of a ship
- **Tanker** – A large ocean going vessel designed to transport massive tanks of liquids; mainly oil or hazardous chemicals
- **Tanks** – An enclosed space used to hold liquids
- **Tow** – To push or pull any object, vessel or barge

- **Tugboat** – A ship designed for push or pull towing: many various designs/hull shapes lend their work to different waters ways including river, harbor, and ocean

Appendix H: What is an IQP and how does this project qualify?

The role of the Interactive Qualifying Project (IQP) is a fundamental part of the WPI curriculum (Office of Interdisciplinary and Global Studies, 2011). This project is a pivotal point in the curriculum that sets WPI apart from other schools. While most schools require one major project in the major field of study for a student, WPI not only has that in the form of a Major Qualifying Project (MQP) but also has the IQP. An IQP is not only a project that is required to pass in order to graduate, but for most students it is also the first time they are going to be working in the real world, trying to solve major problems. It is extremely helpful to have this experience of working in the real world, because it helps to get students accustomed to the environment of the working world. On top of this experience in the working world, the IQP also stresses the importance of the impact that student's work will have not only on the environment but also on society. It helps to show that every bit of work that a person does out in the world has an impact in some way; whether these impacts are immediate or the outcomes are delayed. A good example of this would be the project that our group is working on for the United States Coast Guard (USCG).

Our project is to try and reduce the response time of emergency tugboats throughout the nation. This is a very large issue and also has extremely large consequences. As it stands, the USCG does not think the current response time of emergency towing/firefighting vessels is fast enough. There are several major problems associated with the slow response of an emergency towing vessel. The biggest is the possible loss of life associated with a distressed ship. If an emergency towing vessel is not able to respond quickly enough to a ship in need, the potential for more damage to occur to the distressed ship is greatly increased. This can range from a ship running aground on a hidden sandbar or reef, a ship running into another ship, or even worse, an oil rig. If either of the latter occurs, there is a potential for the loss of life, which is unacceptable. The next biggest issue associated with slow response time of emergency towing/firefighting vessels is the risk to the marine environment.