UNITED STATES COAST GUARD

INVESTIGATION INTO THE CIRCUMSTANCES SURROUNDING THE SINKING OF THE UNINSPECTED FISHING VESSEL

ARCTIC ROSE

OFFICIAL NUMBER 931446, IN THE BERING SEA ON APRIL 2, 2001, WITH ONE PERSON DECEASED AND FOURTEEN PERSONS MISSING AND PRESUMED DEAD

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SINKING OF THE UNINSPECTED FISHING VESSEL ARCTIC ROSE, OFFICIAL NUMBER 931446, IN THE BERING SEA ON APRIL 2, 2001, WITH ONE PERSON DECEASED AND FOURTEEN PERSONS MISSING AND PRESUMED DEAD

ACTION BY THE COMMANDANT

The record and the report of the Marine Board of Investigation convened to investigate the subject casualty have been reviewed. The record and the report, including the findings of fact, analysis, conclusions, and recommendations are approved subject to the following comments.

COMMENTS ON FINDINGS OF FACT

Finding of Fact 7.d, paragraph 1: At 0335, on April 2, 2001, the command center in D17 Juneau received a 406 MHz EPIRB notification over telex. The message identified the EPIRB as registered to the ARCTIC ROSE. The watch supervisor telephoned the company's Seattle, Washington representative provided by the EPIRB signal, Mr. David Olney, and requested he contact the ARCTIC ROSE to determine if the alert was a false alarm. Mr. Olney called back to inform the CC that he was unable to reach the vessel by phone or email. The CC issued an Urgent Marine Information Broadcast (UMIB) alerting all vessels to be on the lookout for the ARCTIC ROSE and/or survivors. Mr. Olney contacted the CC and passed that his company's other vessel, the ALASKAN ROSE was in the area fishing with the ARCTIC ROSE. COMSTA Kodiak attempted to contact the ALASKAN ROSE without success. At approximately 0400, AIRSTA Kodiak launched a C-130 to begin searching for the ARCTIC ROSE. The C-130 and COMSTA attempted to hail the ARCTIC ROSE without success. At approximately 0730, shortly before the C-130's arrival on-scene, contact was made with the ALASKAN ROSE via VHF radio. Mr. John Nelson, who was on watch, informed the C-130 crew that he did not hear of a Mayday or call for assistance from the ARCTIC ROSE and immediately altered the vessel's course to intercept the EPIRB. The mate awoke Captain Anderson and briefed him on the situation. Mr. Nelson tried numerous times to hail the ARCTIC ROSE on VHF radio without success. The ALASKAN ROSE was eleven miles due south of the EPIRB position. It took approximately one hour for the ALASKAN ROSE to arrive on-scene.

Comment: In addition to the UMIB issued by the Coast Guard Seventeenth District's Command Center (D17CC) and the attempts to contact the ALASKAN ROSE by Communications Station (COMSTA) Kodiak and the C-130 aircraft, there were also seven individual INMARSAT C messages sent from the D17CC in Juneau, AK, to the ALASKAN ROSE beginning at 0413. Two were sent over a prototype system operated by COMSAT (now TELNOR), and five were sent over a server, which is no longer in service. The prototype COMSAT system was incapable of initiating a distress-priority message, and the server, while capable of initiating a distress-priority message, did not do so for reasons unknown.

Finding of Fact 16, paragraph 1: Coast Guard COMSTA Kodiak maintains a live twenty-four hour watch. The COMSTA is responsible for monitoring all HF communications for the North Pacific region, which includes the area where the ARCTIC ROSE sank. Communication monitoring equipment is located on Kodiak Island and St. Paul Island. COMSTA Kodiak remotely monitors the St. Paul equipment. The COMSTA monitors 2182 KHz, 4125 KHz, and 6200 KHz distress frequencies from Kodiak. The COMSTA remotely monitors 4125 KHz at the St. Paul Island site. The Bering Sea does not have VHF repeater coverage; only line of site VHF communications is possible.

Comment: Communications Station (COMMSTA) Kodiak also monitors the digital selective calling (DSC) distress and safety frequencies 2187.5, 4207.5, 6312, 8414.5, 12577 and 16804.5 kHz, and can transmit on those frequencies as well. If the ALASKAN ROSE had been equipped with a Global Maritime Distress and Safety System (GMDSS) DSC-equipped single sideband radio, the COMMSTA would have likely been able to trigger an alarm on the vessel and initiate communications, regardless of skip conditions or noise or interference on any one frequency. DSC was designed to allow a receiver to scan the distress and safety channels despite the noise normally associated with HF.

Finding of Fact 16, paragraph 4: HF equipment typically does not have dual watch capabilities that some VHF-FM radios have. Some VHF-FM radios have multiple transceivers or the ability to rapidly scan channels. This feature on VHF radios has allowed some vessels to pick up distress calls. HF equipment can be modified for dual watch capability by installing additional transceivers and antennas on board. However, a rapid scan of HF channels is not practicable due to the excessive static or noise associated with HF.

Comment: Digital selective calling (DSC) was designed to allow a receiver to scan the distress and safety channels despite the background noise normally associated with HF.

Finding of Fact 17.d, paragraph 6: The INMARSAT-C system aboard the ALASKAN ROSE did not have an audible or visual alarm to notify the watchstander of an incoming urgent broadcast. The user would have to go from the steering station to the INMARSAT-C unit and download the messages. Each message would have to be viewed prior to deleting it from the queue. The system operator has to program the INMARSAT-C system to receive messages based on the location of the terminal to avoid overloading the system with excessive messages from other broadcast stations. Mr. John Nelson provided testimony to the Marine Board indicating the ALASKAN ROSE did receive countless messages from Russia but did not receive the distress message until several hours after it was sent by D17 RCC.

Comment: According to INMARSAT, the model INMARSAT-C carried by the ALASKAN ROSE is required by its System Definition Manual (SDM) to have an alarm that cannot be disabled by the operator.

Finding of Fact 18.a, paragraph 1: Voluntary Dockside Exam Program. The ARCTIC ROSE had a voluntary dockside examination based on its operation as an H & G vice a fish processor, receiving a valid CFVSE decal (#74701). It was issued in Unalaska on September 9, 1999, by a

Petty Officer from the Marine Safety Detachment. The Marine Safety Information System case number for the inspection is MI99030162.

Comment: If, as earlier Findings of Fact indicate, the ARCTIC ROSE actually engaged in operations making it a fish processor, then the Commercial Fishing Vessel Safety Examination (CFVSE) decal #74701 issued to the ARCTIC ROSE for Head and Gut operations would have been invalid.

Finding of Fact 18.b, paragraph 1: At Sea Boardings. All vessels including commercial fishing vessels are subject to at sea boardings by the Coast Guard. The Coast Guard's at sea boarding policy is outlined in ALDIST 062/92 and the MLEM Manual COMDTINST M16247.1. The ALDIST message provides guidance for the Coast Guard's cutters to perform at sea boardings and details the safety equipment the boarding team should focus on.

Comment: ALDIST 062/92 was cancelled before the February 25, 2001, boarding of the ARCTIC ROSE by the USCGC STORIS. The applicable reference at the time of the February 25, 2001, boarding was CCGD17 LEB 00-007 (CCGD17 message 182334Z OCT 00).

Finding of Fact 21, paragraph 1: The ARCTIC ROSE was engaged in "Head and Gut" operations. The processors remove the head (by hand or by guillotine) and entrails, then flash freeze the fish. Once frozen, the fish blocks are bagged and placed in the cargo hold for storage until they are offloaded ashore or to a tramper at anchor.

Comment: Testimony provided during the hearing indicated that crewmen on the ARCTIC ROSE prepared fish in ways that by definition meant the ARCTIC ROSE was actually engaged in fish processing rather than only "Head and Gut" operations.

Finding of Fact 21, paragraph 2: The H & G process does not meet the regulatory definition of processing and therefore, the ARCTIC ROSE was exempted from the Processing Vessel regulations found in 46 CFR Part 28, Subpart F. However, testimony by an ex-crew member, Mr. Rafael Olivaris, indicates that the vessel did indeed engage in fish processing by removing tails and fins and was subject to the regulations governing fish processing vessels. A vessel cannot arbitrarily change its status from non-processor such as H & G operations to processing. Once the ARCTIC ROSE engaged in processing, the regulations in 46 CFR Part 28, Subpart F applied. These regulations require a class society or other similarly qualified organization to conduct an examination of the vessel.

Comment: Since testimony provided during the hearing indicated that the ARCTIC ROSE was indeed engaged in fish processing, it was not exempt from the Processing Vessel regulations found in 46 CFR Part 28 Subpart F.

COMMENTS ON CONCLUSIONS

Conclusion 9: The Marine Board identified a software error in the COMSAT system, which reduced the priority of the Safety Alert to a Navigation Warning without the sender's consent or knowledge. The problem resided within the message routing software package for SafetyNET.

This item was resolved in November 2001 with TELENOR updating its software by eliminating the default and allowing the sender to set the message parameter.

Comment: The software error reduced the priority of the Safety Alert from Distress to Safety (one cannot reduce a priority to Navigational Warning since Safety is a priority and Navigational Warning is a service). COMSAT later indicated that this reduction of priority was done because the SafetyNET message header used by the Coast Guard, while recognized by the SafetyNET system, was not recognized by the 1994 edition of the International Maritime Organization's INMARSAT SafetyNET Manual, Annex 4 (Operational Guidance). Instructions provided to Coast Guard watchstanders preceded the Operational Guidance documented in that Manual, and had not been subsequently revised. Both COMSAT's (now TELNOR's) software and Coast Guard procedures have been revised to correct the problem.

Conclusion 10: The use of a fisheries model INMARSAT-C aboard the ALASKAN ROSE, which was not a GMDSS or SOLAS compliant system, affected the alarm and visibility status of any message or alert received. The system operator was handicapped by not having an external printing device or an alarm for signaling the receipt of Safety priority messages. This resulted in the delayed reading of the messages until well after they had been sent by the Coast Guard.

Comment: Global Maritime Distress and Safety System (GMDSS) and fisheries models of INMARSAT both alarm on all distress priority messages and urgency priority SafetyNET messages. No terminal provides an audible alarm on receipt of a safety priority message.

ACTION ON RECOMMENDATIONS

Recommendation 1: The Coast Guard should seek a legislative change to remove the grandfathering provisions provided for in 46 CFR 28.500 and require all fishing vessels and fish processors (including Head and Gut operations) over 79 ft in length to meet the stability requirements in 46 CFR Part 28, Subpart E, or remove the exemption for fishing vessels in 46 CFR Subchapter E and require load line assignment.

Action: We concur with the intent of this recommendation. While we agree that having existing fishing vessels comply with some sort of stability requirements would improve their safety, we do not believe that the implementation of regulatory requirements is the best approach. In addition, the regulations in 46 CFR Chapter I, Subchapter E, which reflect the requirements of the International Load Line Convention (ICLL), 1966, were not designed for application to vessels that routinely operate without hatch covers and with open cargo holds, as is the case with many fishing vessels. Instead, we believe a voluntary compliance program is more appropriate and may be more influential at this time. To implement this voluntary compliance program, we will include this issue in our review and update of Navigation and Vessel Inspection Circular 5-86, *Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels*.

Recommendation 2: The Coast Guard should develop regulations requiring all watertight and weathertight doors, required to be closed by a vessel's stability booklet, to be alarmed and equipped with a visual and audible system in the pilothouse to indicate the position of the door(s).

Action: We concur with the intent of this recommendation. We believe that the fitting of watertight and weathertight doors, required to be closed by a vessel's stability booklet, with alarms and status indicators would improve fishing vessel safety by making masters and crews more aware of the status of their vessel's watertight integrity and alerting them to possible threats of flooding. However, we believe that the development and implementation of a voluntary compliance program rather than attempting to publish regulatory requirements is more appropriate and more likely to be completed faster and with better success. We will consult with the Commercial Fishing Industry Vessel Safety Advisory Committee and work with the industry on the development of appropriate voluntary standards and seek to include the results in an update to Navigation and Vessel Inspection Circular 5-86, *Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels*.

Recommendation 3: All vessels equipped with either a processing space or a space used in the sorting of fish in which water is used should be fitted with high water alarms. These alarms must sound in the processing/sorting space and in the pilothouse.

Action: We concur with this recommendation. We believe that fitting the processing space or other space used for the sorting of fish in which water is used with high water alarms would improve fishing vessel safety by alerting the master and crew of the unsafe condition where too much water is in the space. In addition, we believe that implementing this safety feature as part of a voluntary compliance program is more appropriate than the adoption of a regulatory requirement. As such, we will include this recommended action in an update to Navigation and Vessel Inspection Circular 5-86, *Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels*.

Recommendation 4: The Coast Guard should review and re-evaluate the regulatory definition of processing vessels as it applies to fishing vessels, making sure it includes Head and Gut operations.

Action: We concur with this recommendation. We will review and evaluate the definition of fish processing vessel in the law and regulations and seek to have it amended to ensure that it includes vessels that conduct head and gut operations.

Recommendation 5: The Coast Guard should develop a regulation requiring all fishing vessels to document required drills found in 46 CFR 28.270.

Action: We concur with this recommendation. We believe the documentation of drills will improve the accountability of masters and individuals in charge for ensuring that required instruction and drills take place. We are currently working on a regulatory project that will propose requirements for the documentation of training and drills.

Recommendation 6: Coast Guard Headquarters should remind all field units (Marine Safety and Operational) of the civil penalty provisions found in 46 USC 4507 and their applicability to the regulations found in 46 CFR Part 28.

Action: We concur with this recommendation. We will ensure that all field units are reminded of the civil penalty provisions contained in 46 USC 4507 and their applicability to the regulations in 46 CFR Part 28.

Recommendation 7: In reviewing the overall SafetyNET system, the Marine Board found that there are no requirements for INMARSAT-C use on fishing vessels. This reduces the effectiveness of an important link of the GMDSS system. The Marine Board recommends requiring fishing vessels operating beyond the boundary line to be GMDSS compliant. The Marine Board understands a "one size fits all" requirement may not be the right solution and recommends Commandant evaluate the possibility of a regulation that has a regional approach tied to vessel operations, number of persons on board, duration of voyage, and distance offshore. The FCC and Coast Guard should partner during the development of these regulations.

Action: We concur with this recommendation. Current requirements, as outlined in 46 CFR 28.245, are inadequate for shore-to-ship communications with any vessel fishing outside a coastal area. Working closely with the Federal Communications Commission, we will initiate a rulemaking project to propose regulations requiring appropriate Global Maritime Distress and Safety System (GMDSS) installations on commercial fishing vessels subject to Coast Guard communications requirements.

Recommendation 8: The FCC and Coast Guard should require each fishing vessel equipped with a GMDSS system to have a properly trained operator.

Action: We concur with this recommendation. As part of the rulemaking project described in our action for Recommendation 7, we will seek to include GMDSS operator training requirements that will adhere as closely as possible to existing Federal Communications Commission rules.

Recommendation 9: The Coast Guard should develop a long range automated information system that incorporates two way communications for vessels equipped with a GMDSS satellite communications system, thus providing the Coast Guard with information on the location and identity of vessels operating in U.S. waters. This system could facilitate rescue coordination by providing the location and identity of vessels and two-way communications capability to direct resources to the scene of a vessel in distress.

Action: We partially concur with this recommendation. Systems already exist with the capabilities described in the recommendation. We are currently working at the International Maritime Organization (IMO) to select appropriate systems to be used internationally and to establish standards and requirements for the equipment on board vessels. Once the work at the IMO has been completed, we will evaluate the feasibility of adopting those requirements for US-flagged fishing vessels.

Recommendation 10: The Coast Guard should encourage the use of color graphic displays within a stability booklet that are easily understood by mariners such as the one under development by SNAME.

Action: We concur with this recommendation. The current stability booklet standard only provides a "pass/fail" approach and displays its information in a complex numeric format. The superior color-coded graphic display accounts for sea and wind state and shows the vessel's risk of capsizing in stoplight-type colors. We will include a color-coded matrix for stability guidance in an update to Navigation and Vessel Inspection Circular 5-86, *Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels*.

Recommendation 11: The Coast Guard should review NVIC 5-86 to modernize the policy to reflect the changes in technology. Furthermore, the document should incorporate the MSC technical note 04-95 titled Lightship Change Determination; Weight-Moment Calculation vs. Deadweight Survey vs. Full Stability Test, which addresses weight changes triggering a new stability test for the vessel.

Action: We concur with this recommendation. We will review Navigation and Vessel Inspection Circular 5-86, *Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels,* and revise it to include, among other things, guidance from the Coast Guard Marine Safety Center's Marine Technical Note 04-95.

Recommendation 12: The Coast Guard should promulgate guidance addressing fishing vessel construction standards that minimize the free flow of water through a vessel.

Action: We concur with this recommendation. Guidance regarding fishing vessel construction standards to minimize the free flow of water already exists in Navigation and Vessel Inspection Circular (NVIC) 5-86, *Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels,* and 46 CFR 28.560. We will include this issue in our review of the NVIC and update its guidance as necessary.

Recommendation 13: The Coast Guard should remove all provisions that allow the use of above main deck spaces in the development of a fishing vessel's stability characteristics.

Action: We concur with the intent of this recommendation. Incorporating the weathertight envelope in stability analyses provides an accurate measure of a vessel's stability so long as operational practices do not compromise the spaces' integrity. We believe removing the provisions that allow for the use of main deck spaces that are part of the weathertight envelope would be overly restrictive. However, there may be a need to amend the existing provisions to reduce the likelihood that the integrity of spaces above the main deck spaces that were used in stability analyses could be compromised due to operational practices or other factors. We will include this issue in our review of Navigation and Vessel Inspection Circular 5-86, *Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels,* and update its guidance as necessary.

Recommendation 14: The Coast Guard should review the *significant alteration* and *major modification* policy as it applies to fishing vessels and promulgate guidance for its consistent application.

Action: We concur with the intent of this recommendation. The authority to make a determination of "major conversion" has been vested in the Coast Guard Marine Safety Center

(MSC) by the Commandant. Accordingly, the MSC has developed a clear, comprehensive, and publicly available document to explain the Coast Guard's policy. The policy document is available on the MSC's web site under the "Major Conversion" link or directly at http://www.uscg.mil/hq/msc/PRGuidance/e1-30.pdf. Any member of the industry or a Coast Guard field unit may submit the details of an actual or proposed vessel modification to the MSC for a major conversion determination. The MSC's goal is to respond to requests in two weeks.

Recommendation 15: MSO Anchorage's and D13's dockside boardings of fishing vessels prior to high-risk fisheries to verify lifesaving equipment and stability letter compliance should be considered a best practice for use Coast Guard wide.

Action: We concur with this recommendation. We will forward information regarding MSO Anchorage's and D13's practices to all other Commercial Fishing Vessel Safety Coordinators for use in implementing similar practices within their own area of responsibility.

Recommendation 16: The Coast Guard and the commercial fishing industry should develop a non-regulatory program to encourage fishing vessel owners to track weight changes aboard their vessels and alterations that may impact a vessel's stability.

Action: We concur with this recommendation. We will work with the Commercial Fishing Industry Vessel Safety Advisory Committee to evaluate and develop a process by which fishing vessel owners can track weight changes and alterations that may impact a vessel's stability. The process will be included in our review of Navigation and Vessel Inspection Circular 5-86, *Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels*.

Recommendation 17: The Coast Guard should promulgate a policy to ensure the collection and preservation of all available evidence discovered on the scene of a marine casualty.

Action: We concur with the intent of this recommendation. Policy for the preservation and collection of evidence is contained in the Coast Guard's Marine Safety Manual and associated policy publications. We will review the existing policy, amend it as necessary, and ensure wide distribution of the amended policy.

Recommendation 18: The Coast Guard should consider establishing investigation management teams to fill the positions on a Marine Board.

Action: We concur with the intent of this recommendation. We will establish a team to develop methods and procedures to improve the current process of selecting the members of a Marine Board of Investigation.

Recommendation 19: The Coast Guard and the commercial fishing industry should explore the development of a minimal safety indoctrination program for all first time crew to include processors prior to getting underway and provide a means to document the training.

Action: We concur with the intent of this recommendation. Requirements for safety orientations to be given to each individual on board who has not received the instruction and has not participated in required drills, including first time crew, already exist in 46 CFR 28.270(e).

46 CFR 28.270(f) provides the minimum requirements for safety orientations. We are currently working on a regulatory project that will propose requirements for the documentation of training and drills.

Recommendation 20: The Coast Guard and SNAME should develop regional stability and damage control workshops with a focus on fishing vessels operating within their specific region. The workshops should be a regularly scheduled event to coincide with national events such as COMFISH Expo. The agenda for these events at a minimum should include: stability, damage control, and training requirements. The lessons/demonstrations should employ casualty data to reinforce the lessons.

Action: We concur with this recommendation. We will coordinate with the Society of Naval Architects and Marine Engineers and the Commercial Fishing Industry Vessel Safety Advisory Committee on the selection and implementation of appropriate program options.

Recommendation 21: The Coast Guard, FCC, INMARSAT-C system manufacturers and other safety organizations should develop training for the proper use of fisheries models INMARSAT-C systems. This training should be scheduled as workshops and incorporated as an element of national events such as COMFISH Expo.

Action: We concur with this recommendation. For Global Maritime Distress and Safety System (GMDSS) installations to be useful, the users must be sufficiently trained and able to use them competently and efficiently. Working with the commercial fishing industry and the communication industry, we will seek to develop a program to provide the recommended training.

Recommendation 22: The Coast Guard and NMFS should develop a MOU to facilitate the exchange of safety information obtained from observers serving aboard fishing vessels.

Action: We concur with the intent of this recommendation. We agree that the exchange of safety information obtained from observers would be extremely valuable in our efforts to improve the safety of fishing vessels; however, the development of a new memorandum of understanding (MOU) may not be necessary. As we continue discussions with the National Marine Fisheries Service (NMFS) on this issue, we will consider the possibility of expanding the existing MOU between the U.S. Coast Guard and NMFS, developing a new MOU as recommended, or other means to facilitate the information exchange.

Recommendation 23: The Coast Guard in D17 should develop a similar MOU (as mentioned above) with the Alaska Department of Fish and Game to facilitate the exchange of safety information obtained from observers serving aboard fishing vessels.

Action: We concur with the intent of this recommendation. We will forward this recommendation to the Commander, Seventeenth Coast Guard District, for appropriate action.

Recommendation 24: The D17 staff needs to expand its efforts to promote the "Ready For Sea" program to all U.S. Coast Guard cutters operating in its AOR.

Action: We concur with this recommendation. The Seventeenth Coast Guard District staff has made information on the "Ready For Sea" program available on its intranet website and includes this information in the in-brief packages provided to U.S. Coast Guard cutters operating in the District's area of responsibility.

Recommendation 25: The crew of the ALASKAN ROSE should receive a Public Service Award for their actions and efforts during the recovery phase of the SAR Case. In particular the heroism of the mate, Mr. John Nelson, in the recovery of Captain David Rundall, should be recognized.

Action: We concur with this recommendation. This recommendation will be forwarded to the Commander, Seventeenth Coast Guard District, for his consideration and action.

Recommendation 26: A copy of this report should be provided to the National Transportation Safety Board.

Recommendation 27: A copy of this report should be provided to the International Maritime Organization.

Recommendation 28: A copy of this report should be provided to families of the next-of-kin, members of the Commercial Fishing Industry Vessel Safety Advisory Committee and Arctic Sole Seafoods, Inc., the owner of the ARCTIC ROSE.

Recommendation 29: This report should be given wide dissemination throughout the commercial fishing industry vessel community including major fisheries journals, the National Council on Fishing Vessel Safety and Insurance, the North Pacific Fishing Vessel Owners' Association, The Alaska Marine Safety Education Association, The Society of Naval Architects and Marine Engineers, The Groundfish Forum and other major fishing industry vessel associations in the Pacific Northwest.

Recommendation 30: Notice of this report should be provided to each Coast Guard District Fishing Vessel Safety Coordinator.

Action on Recommendations 26 through 30: We concur with these recommendations. The report will be distributed as recommended.

Recommendation 31: Recommend this investigation be closed.

Action: We concur with this recommendation. This investigation is closed.

T. H. Gilmour

T. H. GILMOUR
REAR ADMIRAL, U.S. COAST GUARD
ASSISTANT COMMANDANT FOR MARINE SAFETY,
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TABLE OF CONTENTS

	Page
LIST OF FIGURES	iv
LIST OF ABBREVIATIONS	v
FINDINGS OF FACT	1
1. SUMMARY	1
2. VESSEL PARTICULARS	1
3. CREWMEMBER INFORMATION	3
4. VESSEL DESCRIPTION	5
a. General	5
b. Hold Level	6
c. Main Deck (Processing) Area	7
d. Main Deck (Berthing and Accommodations) Area	8
e. Main Deck (Trawl Equipment) Area	10
f. Pilothouse and Weather Deck Area	11
g. Processing Space Sideshell Openings	12
h. Watertight/Watertight Doors and Hatches	13
i. Engine	14
j. Shaft Alley	14
k. Kort Nozzle and Rudder	14
5. SAFETY AND LIFESAVING EQUIPMENT	14
6. TRAWLING AND PROCESSING OPERATIONS	15
7. THE CASUALTY	15
a. Departure from Dutch Harbor	15
b. Departure from St. Paul	16
c. Season Opening	16
d. Search and Rescue Case	16
8. OWNERS AND OPERATORS	17
9. ALCOHOL AND DRUG POLICY	18
10. CREW HIRING PRACTICES	18
11. HISTORY OF VESSEL REPAIRS, MODIFICATIONS AND SURVEYS	18
a. Shrimp Boat	18
b. Scallop Boat	19

c. Catcher – Processor Boat - Second Owner and Operator 19
d. Same Owner, New Operator 20
e. Third Owner, Additional Modifications 20

12. UNALASKA OPERATIONS 22

13. FEDERAL REGULATIONS AND OVERSIGHT 22
a. United States Coast Guard 22
b. Federal Communications Commission 23
c. National Marine Fisheries Service 23
d. Occupational Safety and Health Administration 23
e. Applicability to the ARCTIC ROSE 23

14. INDUSTRY STANDARDS AND GUIDELINES 24

15. WEATHER 24

16. COMMUNICATIONS 27

17. SAFETYNET 28
a. System Description 28
b. SafetyNET Services 29
c. USCG SafetyNET Broadcasts 29
d. SafetyNET Receivers 30

18. COMMERCIAL FISHING VESSEL SAFETY PROGRAM 32
a. Voluntary Dockside Exam Program 32
b. At Sea Boardings 32
c. Ready for Sea 33

19. TRAINING 33
a. United States Coast Guard 33
b. Commercial Fishing Vessel Industry 33
c. National Marine Fisheries Service (NMFS Observers) 34
d. ARCTIC ROSE 34

20. NMFS OBSERVER CONNECTION 34

21. HEAD AND GUT OPERATIONS 35

22. VESSEL STABILITY 35

23. REMOTE OPERATED VEHICLE EXPEDITIONS 39
a. First Expedition 39
b. Second Expedition 40

SUMMARY OF FACTS 43

ANALYSIS 48

VESSEL STABILITY 48

ARCTIC ROSE POSITION AND HEADING 49

HEAD AND GUT OPERATION VERSUS PROCESSOR 50

CONCLUSIONS 52

RECOMMENDATIONS 56

APPENDICES

a. Summary of Marine Board Activities
b. HF Propagation Report
c. Stability Analysis
d. ROV Expeditions

LIST OF FIGURES

Figure 1 Profile drawing of ARCTIC ROSE
Figure 2 Hold Plan drawing of ARCTIC ROSE
Figure 3 Location of machinery in main and auxiliary machinery spaces
Figure 4 Drawing of Processing Space
Figure 5 Main Deck Drawing
Figure 6 Drawing of Weather Deck
Figure 7 View of the primary steering station aboard F/V TENACITY
Figure 8 Photo of PVC deck drain cap
Figure 9 Factory Drawing showing location of sideshell penetrations
Figure 10 Partially open overboard discharge chute on starboard side of ARCTIC ROSE
Figure 11 Drawing showing locations of the weathertight or watertight doors and hatches
Figure 12 Photo of SEA POWER
Figure 13 Port view of TENACITY
Figure 14 Profile drawing showing location of keel shoe
Figure 15 Photo of "A" frame gantry
Figure 16 Photo of Stability Vanes
Figure 17 Photo of plate freezer similar to those aboard ARCTIC ROSE
Figure 18 Photo of sump pump similar to those aboard the ARCTIC ROSE
Figure 19 National Weather Service Surface Analysis for 4am April 2, 2001
Figure 20 National Weather Service Hindcast for 4am April 2, 2001.
Figure 21 Graphic depiction of a Skip Zone
Figure 22 Diagram of SafetyNET Network
Figure 23 Deck Loading Table from ARCTIC ROSE Stability Booklet
Figure 24 SNAME graphic stability chart
Figure 25 Photo of Klein 5000 side scanning sonar
Figure 26 Photo of Phantom HD2 ROV
Figure 27 Picture from side scanning sonar of ARCTIC ROSE
Figure 28 Photo of Arctic Rose
Figure 29 Photo of MAXRover deployed during second expedition
Figure 30 Photo of open weathertight door on aft bulkhead of processing space taken from ROV video
Figure 31 Universal plotting sheet depicting relative position and heading of ARCTIC ROSE on April 1 and 2

LIST OF ABBREVIATIONS

ABS	American Bureau of Shipping
aka	Also Known As
ALDIST	Coast Guard Message distribution title
AIRSTA	Air Station
AOR	Area Of Responsibility
AST	Alaska Standard Time
AZG	Righting Arm (uncorrected for flooding weight)
CC	Command Center
CES	Coast Earth Station
CFR	Code of Federal Regulations
CFVSE	Commercial Fishing Vessel Safety Exam
COC	Certificate of Compliance
COMDTINST	Commandant's Instruction
COMSTA	Coast Guard Communications Station
CWO	Chief Warrant Officer
cu ft	Cubic Feet
DOB	Date of Birth
D17	Coast Guard Seventeenth District
EPIRB	Emergency Position Indicating Radio Beacon
FO	Fuel Oil
FS	Free Surface Effect
F/V	Fishing Vessel
Gals	Gallons
GMDSS	Global Maritime Distress and Safety System
G-MOC	Assistant Commandant for Marine Safety and Environmental Protection Office of Compliance
GOA	Gulf of Alaska
GPS	Global Positioning System
H & G	Head and Gut
HR	Human Resource
IFQ	Individual Fish Quota
INMARSAT	International Maritime Satellite Organization
ISE	Initial Safety Exam
ITC	International Tonnage Convention
KGF	Weight and Location of Flooding Water
KW	Kilowatt
LLC	Limited Liability Corporation
LT	Long Ton
MDE	Main Diesel Engine
moc	District Office of Compliance
MSC	Marine Safety Center
MSD	Marine Safety Detachment
MSI	Maritime Safety Information
MSO	Marine Safety Office

NAVTEX	Navigational Telex
NM	Nautical Mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NOK	Next of Kin
NPFVOA	North Pacific Fishing Vessel Owner's Association
NVIC	Navigation and Vessel Inspection Circular
NWS	National Weather Service
ole	District Office of Law Enforcement
O.N.	Official Number
PFD	Personal Floatation Device
PVC	Polyvinyl Chloride
RA	Righting Arm
RCC	Rescue Coordination Center
REC	Regional Examination Center
ROV	Remote Operated Vehicle
SAR	Search and Rescue
SES	Ship-Earth-Station
SIO	Senior Investigating Officer
SNAME	Society of Naval Architects and Marine Engineers
SOLAS	Safety Of Life At Sea
SSB	Single Side Band (radio)
SSN	Social Security Number
UMIB	Urgent Marine Information Broadcast
USC	United States Code
USCG	United States Coast Guard
USCGC	United States Coast Guard Cutter
VHF	Very High Frequency
WAGB	Coast Guard Arctic Glacial Breaker
WHEC	Coast Guard High Endurance Cutter
WMEC	Coast Guard Medium Endurance Cutter

16732 F/V ARCTIC ROSE
September 2, 2003

From: Marine Board of Investigation
To: Commandant (G-MOA)

Subj: UNINSPECTED FISHING VESSEL ARCTIC ROSE (ex TENACITY and SEA POWER), O.N. D931446, SINKING IN THE BERING SEA WITH ONE PERSON DECEASED AND FOURTEEN PERSONS MISSING AND PRESUMED DEAD

FINDINGS OF FACT

1. SUMMARY

On March 26, 2001, the fishing vessel ARCTIC ROSE, O.N. 931446 departed Dutch Harbor for the Bering Sea fishing grounds near Zemchug Canyon. The vessel made several uneventful tows on the Slime Banks and proceeded to St. Paul, Alaska to take on fuel oil and top off the potable water tanks. On March 30, 2001 the vessel departed St. Paul for the Zemchug Canyon area to fish the April 1st flathead sole opening. They made several tows, securing fishing operations during the evening. The ARCTIC ROSE sank between 2200 April 1, 2001 and 0335 April 2, 2001 (all times are Alaska Standard Time). The D17 CC received a 406MHz EPIRB alert at 0335, issued an Urgent Marine Information Broadcast (UMIB) and sent an INMARSAT-C message to all stations to alert other vessels. A Search and Rescue case was initiated and USCG aircraft were sent to the EPIRB location. At 0840, a Coast Guard C-130 arrived on-scene and located the vessel's EBIRB at 58°56.9'N/175°56.3'W. A large debris field and oil sheen was found in the vicinity. A nearby fishing vessel eventually responded to the UMIB and joined the SAR efforts. Shortly after arriving on-scene, the F/V ALASKAN ROSE recovered the body of David Rundall from the water. A subsequent search by Coast Guard aircraft, two cutters and two samaritan fishing vessels in the immediate area failed to recover additional personnel. Fourteen persons are missing at sea and presumed dead.

2. VESSEL PARTICULARS:

Name:	ARCTIC ROSE (ex TENACITY and SEA POWER)
Official Number:	931446
Service:	Fishing
Document Endorsements:	Coastwise, Fishery, Registry
Gross/Net/ITC Tonnage:	199/135/231
Registered Length:	92.6 Feet
Registered Breadth:	24.5 Feet

Registered Depth:	12.1 Feet
Place Constructed:	Covacevich Boat Works Biloxi, MS
Year Built:	1988
Hull Material:	Steel
Place Converted:	SEA-FAB Inc. Pascaguola, MS
Year Converted:	1991
Propulsion:	Diesel, Single 6170 Luger with Kort Nozzle
Horsepower:	700
Market Value:	$644,000.00
Homeport:	Seattle, WA
Inclining Test Conducted:	March 31, 1999
Date of Recent Stability and Trim Booklet:	July 7, 1999
Last Drydocked:	May/June 1999
Load Line Certificate:	None
CFVSE Decal:	74701
Port Issued:	Dutch Harbor
Inspection Office:	MSD Unalaska
Date Issued:	September 9, 1999
Owner:	ARCTIC ROSE, LLC. 3824 18th Ave., W Seattle, WA 98119

Operator:	ARCTIC ROSE, LLC. 3824 18th Ave., W Seattle, WA 98119
Master:	David Rundall
License:	792863 Issue 1-3 Master of Steam or Motor Vessels of Not More Than 1600 Gross Regulatory Tons Upon Oceans Route. Radar Observer (Unlimited) Endorsement Expires 13 August 2002 Merchant Mariners Document Any Unlicensed Rating in Deck Department including AB.
Issued:	May 22, 2000 at Puget Sound REC
Mate:	Kerry Egan
License:	None
Chief Engineer:	Michael Olney
License:	None
Asst. Engineer:	G. W. Kandris
License:	None

Note 1: The ARCTIC ROSE was less than 200 gross tons and not subject to the licensing and manning requirements of the Officers' Competency Certificates Convention, 1936 (46 USC 8304), which requires a Master of a vessel to be a licensed deck officer.

3. CREWMEMBER INFORMATION

On April 2, 2001

Name: David Rundall
Position: Master
Hired by Arctic Rose LLC: June 2000
SSN: 532-82-8707 DOB: August 11, 1966

Name: Kerry Egan
Position: Mate
Hired by Arctic Rose LLC: March 2001
SSN: 474-70-5807 DOB: January 9, 1956

Name: Michael Olney
Position: Chief Engineer
Hired by Arctic Rose LLC: March 1999
SSN: 533-60-4717 DOB: April 29, 1954

Name: G.W. Kandris
Position: Asst. Engineer
Hired by Arctic Rose LLC: January 2001
SSN: 533-76-4491 DOB: October 6, 1974

Name: Kenneth R. Kivlin
Position: Cook
Hired by Arctic Rose LLC: February 2001
SSN: 041-36-8870 DOB: October 22, 1946

Name: Angel Mendez
Position: Bosun
Hired by Arctic Rose LLC: June 2000
SSN: 455-97-0219 DOB: May 6, 1964

Name: Jimmy L. Conrad
Position: Assistant Factory Foreman
Hired by Arctic Rose LLC: June 2000
SSN: 288-72-0140 DOB: May 17, 1976

Name: Edward F. Haynes
Position: Deckhand
Hired by Arctic Rose LLC: January 2001
SSN: 538-76-4252 DOB: May 29, 1960

Name: Arron Broderick
Position: Factory Foreman
Hired by Arctic Rose LLC: March 2000
SSN: 509-88-6961 DOB: November 23, 1973

Name: James A. Mills
Position: Processor
Hired by Arctic Rose LLC: January 2001
SSN: 516-78-7400 DOB: August 24, 1977

Name: Shawn M. Bouchard
Position: Processor
Hired by Arctic Rose LLC: January 2001
SSN: 517-04-6453 DOB: September 15, 1975

Name: Jeff Meincke
Position: Combi
Hired by Arctic Rose LLC: January 2001
SSN: 535-06-7715 DOB: November 6, 1980

Name: Austreberto Opoll aka Robert Foreman
Position: Processor
Hired by Arctic Rose LLC: January 2001
SSN: 547-67-1428 DOB: Unknown

Name: Justine Opoll Romero aka Michael Nevreiter
Position: Processor
Hired by Arctic Rose LLC: January 2001
SSN: 537-53-6481 DOB: Unknown

Name: Alejandro Espino aka David Whitton
Position: Processor
Hired by Arctic Rose LLC: January 2001
SSN: 548-35-1654 DOB: Unknown

Note 2: According to U.S. Department of Justice, Immigration and Naturalization Service records Austreberto Opoll, aka Robert Foreman, Justine Opoll Romero aka Michael Nevreiter, and Alejandro Espino aka David Whitton (all Mexican Nationals working under aliases) were not documented for employment in the United States.

4. VESSEL DESCRIPTION

a. General. The ARCTIC ROSE was a ninety-two foot fishing vessel, western rigged with the pilothouse forward and trawl deck aft with a large "A" frame gantry at the stern which operated primarily in the Gulf of Alaska and Bering Sea. The vessel operated as a H & G processor. The catch was deheaded and gutted in preparation for freezing and packaging in the processing space.

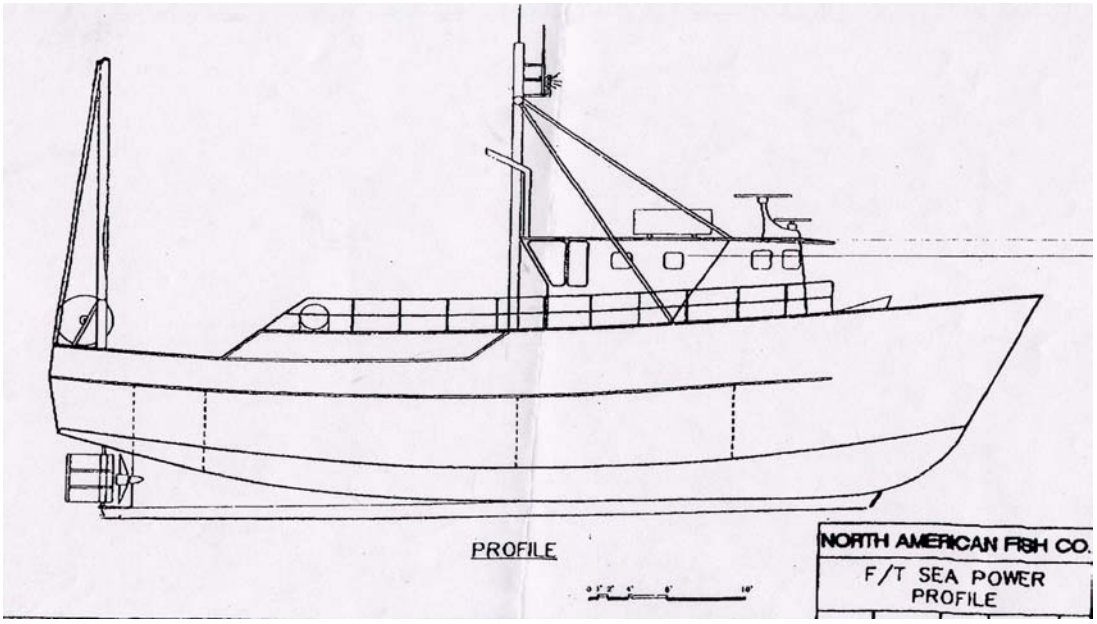


Figure 1
Profile drawing of ARCTIC ROSE

b. Hold Level. The hold level contained multiple compartments as shown in figure (2).

1) Forepeak. This tank was used as a potable water tank with a capacity of 3,646 gals of water.

2) Auxiliary machinery space. This space located aft of the forepeak tank contained the

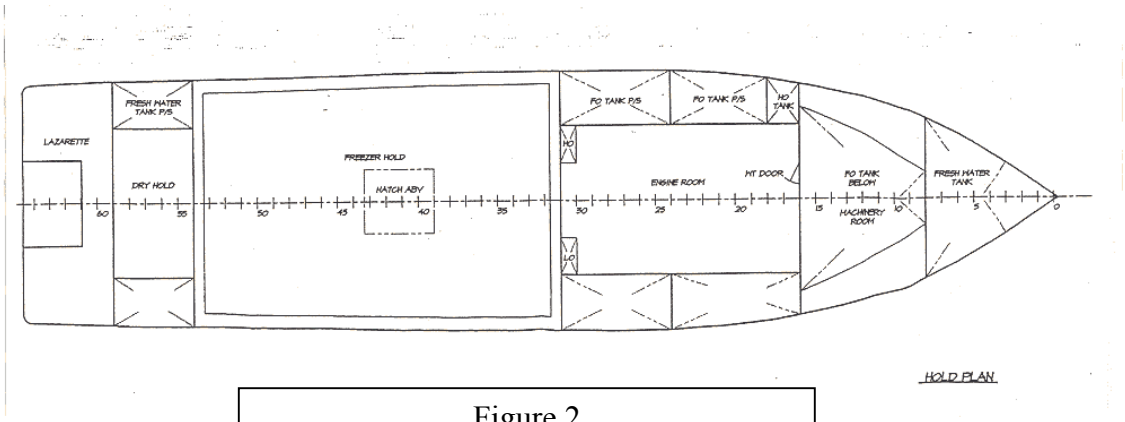
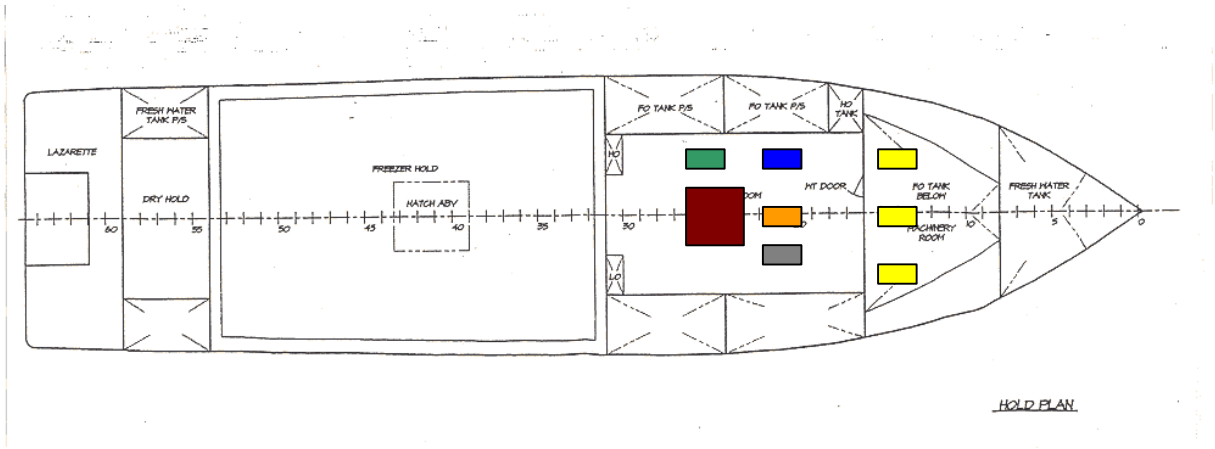


Figure 2
Hold Plan drawing of ARCTIC ROSE

three compressors for the refrigeration system. Batteries for the vessel's electrical system were located in this space. Seven batteries connected in a series provided a 32 volt system for the pilothouse electronics. One 12 volt battery was used for emergency power to the VHF radio. These batteries were mounted up high on a bulkhead to provide protection from any water/flooding. Three trickle charge battery chargers were connected to the batteries to maintain their charge. Below this machinery space was a double bottom fuel tank with a capacity of 3,038 gallons.

3) Main engine room. Centerline in the space was the main diesel engine, a Luger 6170. Power was transferred from the engine to the shaft via reduction gear. The shaft penetrated the watertight bulkhead into the shaft alley. There was a John Deere generator in the space that provided ship service. The generator was located near the forward bulkhead on the port side of the engineroom and was aligned fore and aft within the space. A smaller John Deere generator was located just aft on the port side of the vessel. In between the generators was one 12 volt battery which provided starting power to either generator. A Cummins generator was located forward of the main engine on the centerline of the space, and on the starboard side of the vessel was a Detroit Diesel V671 engine that provided power for the hydraulic system. There was a 12 volt battery in between the Cummins generator and the Detroit Diesel engine used for starting power for either engine. Outboard of the engineroom were four wing tanks holding hydraulic and fuel oil. The No. 2 port wing tank was split to form a hydraulic oil tank and a fuel oil tank. The capacities of these tanks were: No.2 port tank 579 gallons of hydraulic oil and 2,429 gallons of fuel oil, No. 2 starboard tank 3,008 gallons of fuel oil, and No. 3 port and starboard tanks 3,222 gallons fuel oil each.



Main Diesel Engine	John Deere Ship Service Generator	John Deere Generator
Detroit Diesel 671	Cummins Generator	Refrigeration System Compressors

Figure 3
Location of machinery in main and auxiliary machinery spaces
Note: locations are approximate

4) Cargo (freezer). This space had a capacity of 3,755 cu ft, capable of storing approximately 175,000 lbs of frozen fish product. Access to this space was through a hatch in the floor in the processing space above (see Figure 2). The processed and bagged fish was stacked in the hold according to species and size. A stacking procedure, rather than binboards, was relied upon to keep the cargo from shifting in the cargo hold. There was access to shaft alley through a hatch in the deck which was bolted in place. Once fish was placed in the cargo hold, there was no access to the shaft alley.

5) Dry hold. This space had a capacity of 810 cu ft and was used to store spare netting, cod ends and cable. This space was located adjacent to the cargo hold and access to this space was through a hatch on the main deck. In order to open the hatch, the dump truck arrangement had to be lifted out of the way with the gilson winches. This space contained two potable water tanks with a capacity of 1,463 gallons, one each on the port and starboard sides.

6) Lazarette. This space was the aft-most space of the vessel, which contained the vessel's hydraulic double ram steering gear system.

c. Main Deck (Processing) Area. The processing area contained all the equipment for processing the fish as seen in Figure 4. The catch passed from the deck to a live bin through a hydraulically operated sliding hatch on the aft bulkhead. The fish were sorted according to keepers and bycatch. The bycatch was placed on a conveyor belt and discarded through a chute. The target species were taken by conveyor belt to the deheading machine. Once deheaded, the fish were taken via conveyor belt to the cleaning area. There the fish were

cleaned of all viscera and blood. The fish were forwarded to the sorting area, sorted according to species and size, placed into trays and frozen in plate freezers. Frozen fish were placed into bags for shipment and stacked in the freezer hold.

d. Main Deck (Berthing and Accommodations) Area

1) Dry Stores. A small dry storage space was located at the stem of the vessel. Plans (see Figure 5) show this space as a stateroom, but testimony provided to the Marine Board indicates the space was used for dry stores.

2) Berthing and Accommodations. There were four state rooms forward of the galley; two to port and two to starboard with a centerline passageway. The staterooms had the following configuration: port forward was a two person stateroom; port aft was a six person stateroom. The starboard forward stateroom was the Chief Engineer's room; inside this stateroom was an access to the machinery spaces. Starboard aft was a six person stateroom.

3) Galley. The mess area was located just aft of the berthing area and primarily offset to the port side of the vessel.

4) Mudroom. The mudroom was located athwartships of the galley on the starboard side of the vessel. This space was accessed through a standard household door leading to the galley or through a weathertight door leading to the processing space. Testimony provided to the Marine Board indicated this weathertight door was always open, either tied or blocked open with stores. A stairway leading from the mudroom up to the pilothouse served as the primary avenue of escape from the accommodation spaces. The engineroom escape trunk was behind a hollow household door. The crew's head was located to starboard of the pilothouse stairway.

5) Processing Space. This space contained the equipment for processing fish as shown in Figure (4).

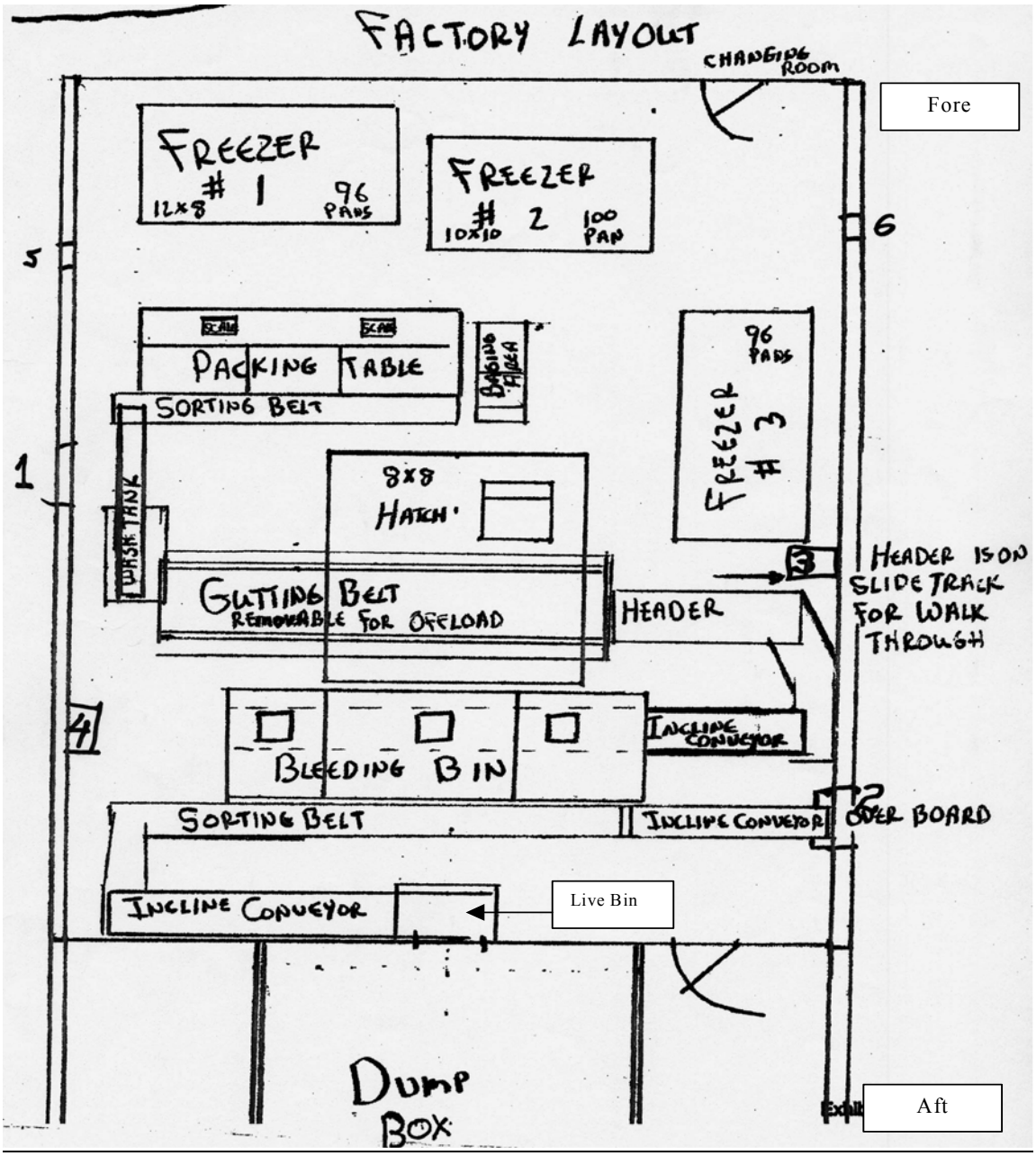


Figure 4
Drawing of Processing Space

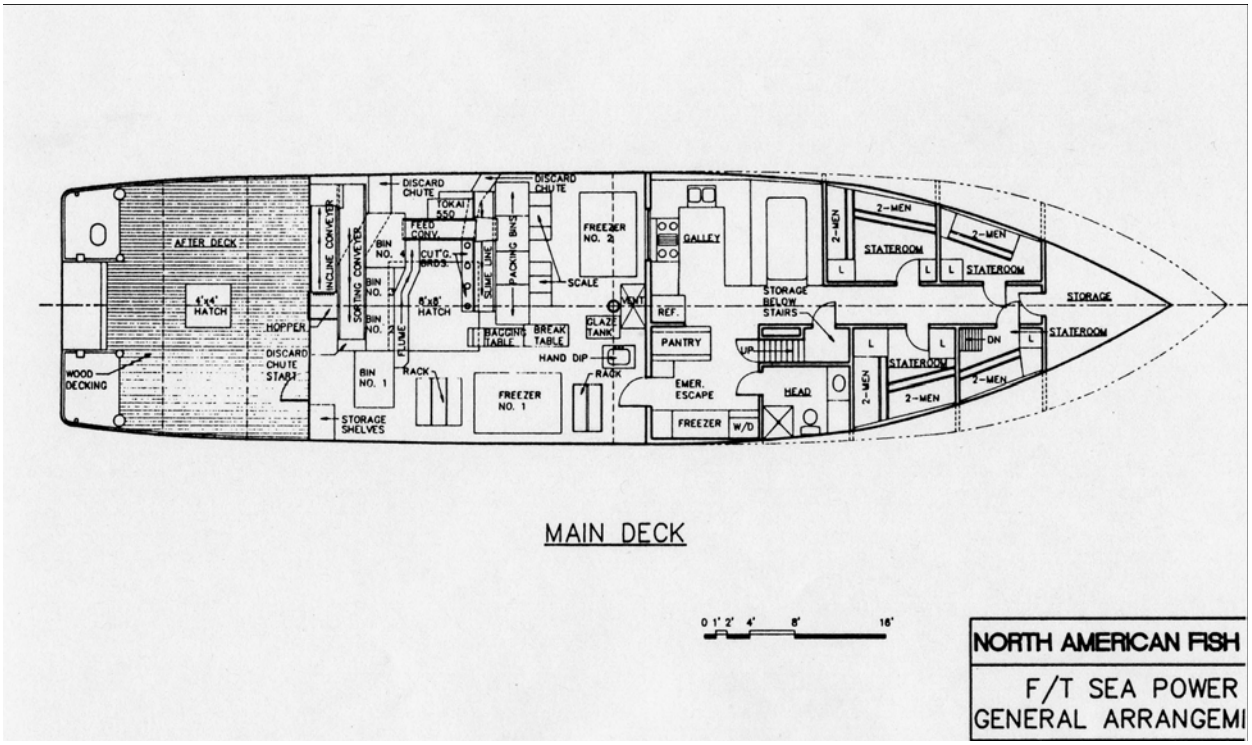


Figure 5
Main Deck Drawing (Disregard Processing space and refer to Figure 4 for correct details)

e. Main Deck (Trawl Equipment) Area. Immediately aft of the processing space was the fish bin, known as the "dump box". The dump box was a pivoted rectangular box that is of similar appearance to that of shore side dump trucks. This dump box arrangement had an approximate capacity of 435 cu. ft. or approximately 10 tons of fish. The trawl net was hauled aboard the vessel through the net ramp, rolled on the net reel and the cod end was placed in the dump box. The crew used gilson winches to help drag and lift the cod end into the dump box. The tailgate of the truck bed was lifted into place and held in position by pins. Once the tailgate was secured, the crew would unzip the cod end dumping the fish into the dump box. Aft of the dump box at the stern of the vessel was the "A" frame gantry. Suspended within the gantry was the net reel. Near the port base of the gantry was the flush deck hatch to the lazarette.

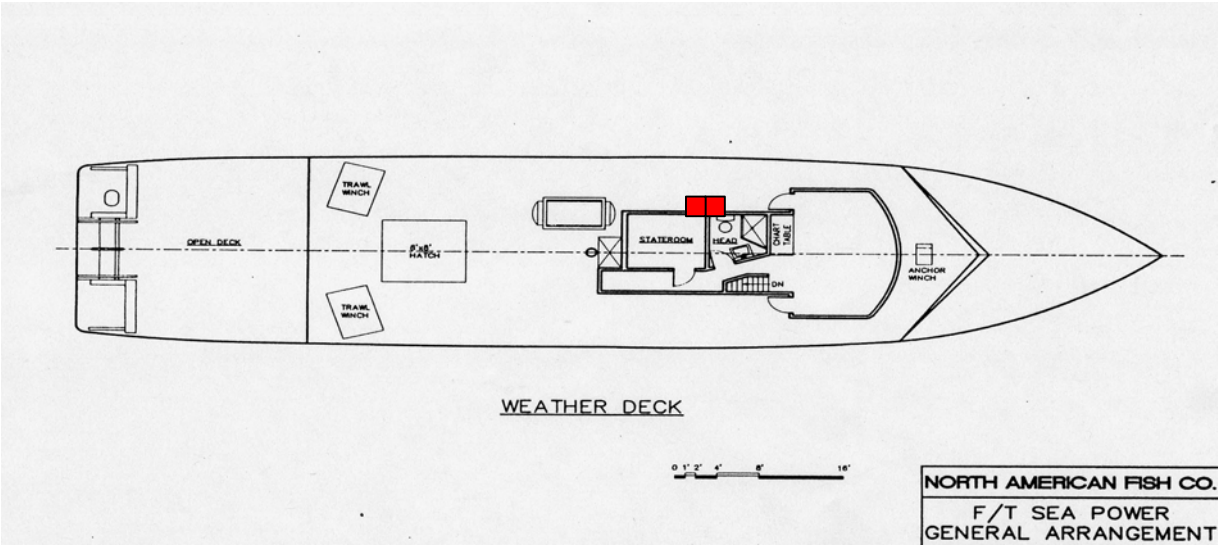


Figure 6
Drawing of weather deck
The red boxes are the proximate location of the wooden boxes

f. Pilothouse and Weather Deck. The pilothouse had three helm stations. The primary steering station was located on the starboard side of the pilothouse, a second station was positioned amidships, and the third station was facing aft which was used for deploying and retrieving trawl gear. Portside, just aft of the pilothouse door, were two wooden boxes. One was used to store spare gear and the other to store the immersion suits, which were stowed inside their bags. Each box was secured shut by a hasp or latch. Aft of the pilothouse was the master's cabin. Just aft of the cabin was an open deck used for mending nets. A small pedestal deck crane with associated controls and port and starboard trawl winches were located at the aft end of this deck. This crane was used for loading provisions and unloading cargo.

3 - Primary conning station.

Figure 7
View of the primary steering station aboard F/V TENACITY (1996)

The equipment locations were as below:

1. Communications Equipment. The vessel had 3 VHF radios - Ross, Stevens and Motorola, Stevens SEA 222 SSB, and a Trimble TNL 7001 Galaxy INMARSAT–C. Arctic Sole Seafoods subscribed to STRATOS MOBILE to provide e-mail service to the vessel.

2. Navigation Equipment. The vessel had 1 magnetic compass, 1 gyro compass, 1 depth sounder, Furuno LP 90 Loran, Furuno CH 24 Sonar, Furuno 1931 marine radar, Furuno GD 180 plotter, and a Trimble Navtrack GPS.

3. Lifesaving Equipment. The EPIRB was mounted outside on the weatherdeck, on the starboard side of the vessel. The inflatable life raft was mounted on the roof of the pilothouse forward of the mast. Two ring buoys were mounted on the port and starboard weather deck bulkheads. There was a wooden box on the port side (See Figure 6) used for the stowage of seventeen immersion suits. Signal flares were kept in a watertight container on the bridge.

g. Processing Space Sideshell Openings. There were a total of six sideshell penetrations in the processing space. Four of these openings (2 port and 2 starboard) were approximately 2-3 inches above the deck. These openings were closed by a threaded PVC cap that could be removed (unscrewed) from inside the processing space to allow excess water to drain overboard. Two rectangular shaped openings (1 port and 1 starboard) were overboard discharge chutes to discard by-catch (starboard) and to discharge waste (port) from fish processing.

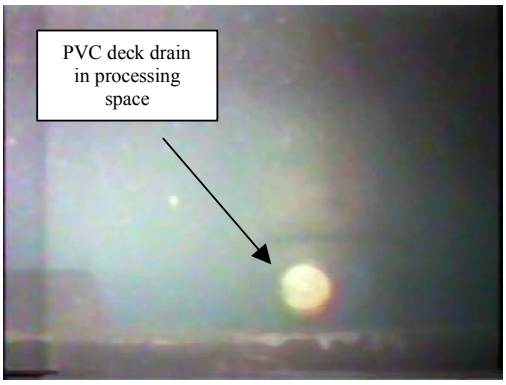
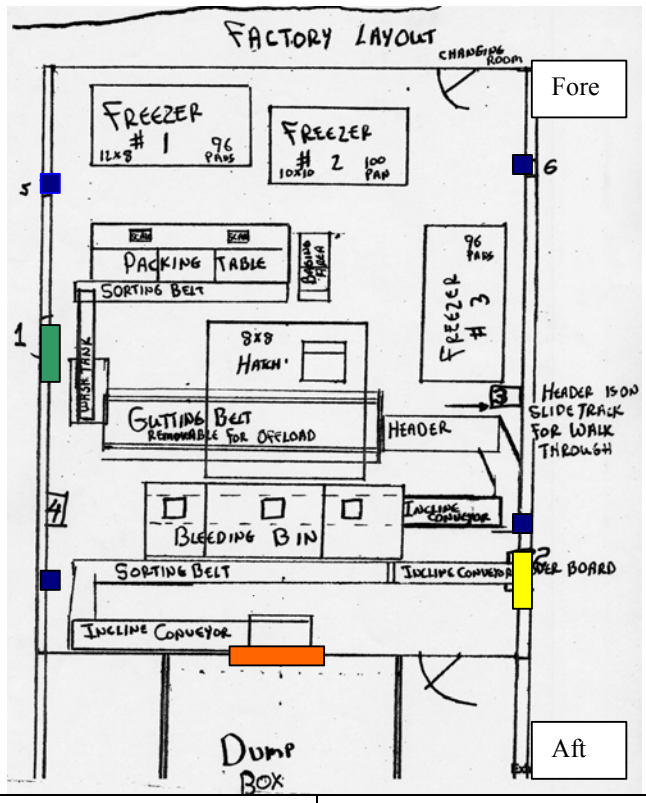


Figure 8
Photo of PVC deck drain cap (2001)



Bycatch discharge chute	PVC drain plugs
Overboard discard chute fish waste	Hydraulically operated weathertight door

Figure 9
Factory Drawing showing location of sideshell penetrations

Note: All positions are approximate

Figure 10
Partially open overboard discharge chute on starboard side of ARCTIC ROSE (2001)

h. Watertight/Weathertight Doors and Hatches. There was a six-dog weathertight door located on the starboard side that opened out to the trawl deck, and a slide hatch located on the aft bulkhead of the processing space. The sliding weathertight chute on the aft bulkhead

facilitated the movement of the catch from the dump box to the processing space. The overhead of the processing space had a weathertight hatch used to offload product. The processing space had six sideshell openings. A small manhole with a raised coaming was located in the top of the deck hatch, which was fitted with a non-watertight or weathertight plywood cover. A weathertight door provided access from the processing space to the mudroom. Access to the engineroom was via a flush deck trunk. A hatch cover was not fitted over the engineroom trunk. There was a watertight door between the engineroom and auxiliary machinery space and a non-watertight hatch between the engineer's stateroom and the auxiliary machinery space. The Jensen Marine Consultants (JMC) issued stability booklet required this watertight door to remain shut at all times except when used for passage. This same book required all openings for scrap and fish chutes in the processing space bulkhead to be kept closed at all times except when used while processing fish.

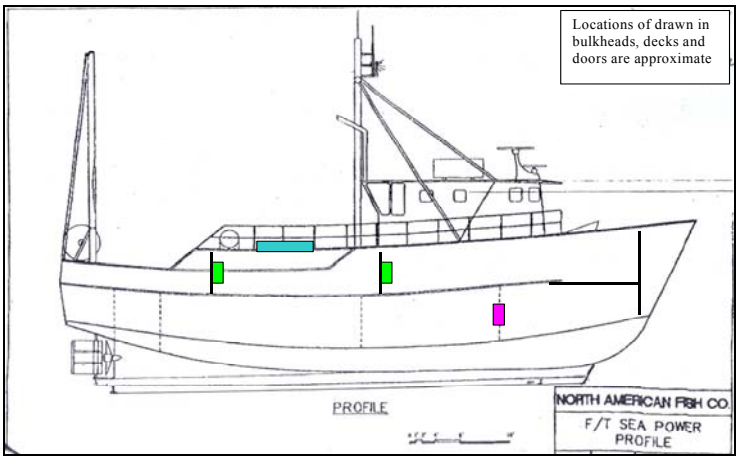


Figure 11
Drawing showing locations of the weathertight or watertight doors and hatches

Watertight Door	Weathertight Door	Weathertight Hatch

i. Engine. The main engine provided a maximum of 700 horsepower, which enabled the vessel to trawl at speeds between three and five knots. The MDE's performance was not affected by the use of gilson winches during fishing operations as the vessel was equipped with an auxiliary engine for running hydraulic gear and winches during hauling back of the cod end.

j. Shaft Alley. The shaft alley ran aft of the main machinery space under the freezer hold into the skeg. There was access into the shaft alley from the freezer hold through deck plates, which were bolted in place. The shaft was fabricated in several sections joined by flanged fittings and supported by bearings.

k. Kort Nozzle and Rudder. The ARCTIC ROSE was equipped with a single kort nozzle with a fixed pitch propeller. A single rudder was mounted just aft of the kort nozzle housing.

5. SAFETY AND LIFESAVING EQUIPMENT

The vessel was equipped with a BF Goodrich 20-person inflatable life raft. There were seventeen immersion suits from Sterns, Bailey Suit, and Harvey aboard the vessel. The immersion suits were equipped with retroreflective tape, waterlights and whistles.

The vessel was equipped with an ACR Electronics, Inc., 406 MHz EPIRB, serial number – 0735/1999 and model number RLB-32. The expiration date of the EPIRB battery was November 2005. The EPIRB was properly registered with NOAA with the current data on file.

Most of the safety equipment aboard the ARCTIC ROSE functioned properly. The EPIRB deployed and emitted a signal, which was received by the orbiting satellite. The signal was then forwarded to the land station and sent via phone line to the Command Center in Juneau, Alaska alerting the watchstanders. The vessel's inflatable liferaft did deploy and was found in an upright condition (although it was empty). The vessel's two ring buoys were never located.

Captain Rundall's body was located within the debris field in a properly donned immersion suit. The immersion suit was full of water. The immersion suits were stowed in a wooden box at the port side of the pilothouse level on the weather deck (see Figure 6). Seven empty immersion suits were recovered by the vessels on scene, all of which were found out of their storage bags.

6. TRAWLING AND PROCESSING OPERATIONS

The ARCTIC ROSE was a stern trawler targeting the non-limited entry permit bottom fisheries (e.g., Pacific Cod, Rex Sole, Flathead Sole, Yellowfin Sole, and other bottom dwellers). The crew would deploy the trawl net to the ocean floor dragging the bottom for several hours at a time. When the operator felt the drag increase or reached the time limit for fishing, the net was retrieved. The cables were retrieved and spooled on winches located aft of the pilothouse on the weather deck. The net was hauled aboard the vessel through the stern ramp and spooled on the net reel mounted within the "A" frame gantry. The cod end was hauled up the stern ramp and pulled into the dump box arrangement. The cod end was manipulated through the use of gilson winches and placed within the dump box. When the cod end was in place, the deckhands would attach a gilson line to the aft door of the dump box, lift the door into place and latch it shut. The cod end would be unzipped to empty the catch into the dump box. The hydraulically operated sliding chute on the aft bulkhead of the processing space could then be opened and the fish manually pushed into the live bin within the processing space where the catch was sorted by species. The by-catch (undesirable species) were placed on a conveyor belt and discarded through an overboard chute on the starboard side of the processing space. A separate conveyor belt carried the target species to the deheading machine. Once deheaded, the fish moved via conveyor belt to the cleaning area where they were cleaned of all viscera and blood. The head and guts were discarded through an overboard chute on the port side. Cleaned fish were sorted, placed onto trays, and inserted into one of the three plate freezers. After three to four hours in a freezer, the frozen fish were put into paper bags referred to as fiber. The bags of fish were marked and dropped into the cargo hold via the manhole access in the deck hatch to be stacked.

7. THE CASUALTY

a. Departure from Dutch Harbor. The vessel topped off fuel on March 22, taking on 10,580 gals of fuel and an unknown quantity of water from Offshore Industry Systems. On March 28, 2001 the ARCTIC ROSE departed Captains Bay, Unalaska, Alaska with a fifteen man crew. Prior to calling on the port of St. Paul, the crew made several trawls in the Bering Sea in an area known as the Slime Banks that produced a small amount of yellow fin sole.

b. Departure from St. Paul. The vessel's last port of call was St. Paul on March 30, 2001, where it topped off fuel and water tanks at North Pacific Fuel Dock, taking on 3,591 gals of diesel fuel and an unknown amount of water. The vessel did not offload cargo while in port. The vessel departed St. Paul and sailed for the Zemchug Canyon Bering Sea fishing grounds to participate in the flathead sole B season that opened April 1. The transit to the fishing grounds took approximately thirty six hours.

c. Season Opening. The April 1st flathead sole opening lasted for three weeks. During this season, flathead sole often contain roe which brings higher profits. The fish with roe are marketed for consumption in Asia. Flathead sole are predominantly bottom dwellers and occupy the sea floor during the day. At night they tend to rise off the sea floor into the water column. Therefore, the most opportune time to catch flathead sole with trawl gear is during the day. On April 1st, the ARCTIC ROSE crew made two trawl sets in search of flathead sole. The first trawl was unremarkable, yielding little marketable fish. The second trawl was completed around 2000-2100 hours and yielded a fifty percent flathead sole catch. Captain Rundall's intention was to remain in the general vicinity and begin fishing again in the morning. The vessel was set on a jogging course (jogging is when a vessel will run a set course at minimal speed to hold a position) to position it for an early morning April 2nd trawl set. The ALASKAN ROSE was operating in the same area, within ten to fifteen miles of ARCTIC ROSE. The ALASKAN ROSE is also owned and operated by Arctic Sole Seafoods. At approximately 2230 on April 1st, Captain Rundall spoke with Captain Norman Anderson of the ALASKAN ROSE and stated that earlier in the day garbage had been left in the processing space, which plugged the chopper sump pump. The problem was corrected but Captain Rundall expressed his displeasure with the event. At approximately 2200 to 2230, the mate, Mr. John Nelson, of the ALASKAN ROSE and Captain Rundall held a brief discussion concerning the day's events. Captain Rundall did not report any mechanical problems or other concerns. Mr. Nelson testified that he last saw the ARCTIC ROSE on radar at approximately 2359.

d. Search and Rescue Case. At 0335, on April 2, 2001, the command center in D17 Juneau received a 406 MHz EPIRB notification over telex. The message identified the EPIRB registered to the ARCTIC ROSE. The watch supervisor telephoned the company's Seattle, Washington representative provided by the EPIRB signal, Mr. David Olney, and requested he contact the ARCTIC ROSE to determine if the alert was a false alarm. Mr. Olney called back to inform the CC that he was unable to reach the vessel by phone or email. The CC issued an Urgent Marine Information Broadcast (UMIB) alerting all vessels to be on the lookout for the ARCTIC ROSE and/or survivors. Mr. Olney contacted the CC and passed that his company's other vessel, the ALASKAN ROSE was in the area fishing with the ARCTIC ROSE. COMSTA Kodiak attempted to contact the ALASKAN ROSE without success. At approximately 0400, AIRSTA Kodiak launched a C-130 to begin searching for the ARCTIC ROSE. The C-130 and COMSTA attempted to hail the ARCTIC ROSE without success. At approximately 0730, shortly before the C-130's arrival on-scene, contact was made with the ALASKAN ROSE via VHF radio. Mr. John Nelson, who was on watch, informed the C-130 crew that he did not hear of a Mayday or call for assistance from the ARCTIC ROSE and immediately altered the vessel's course to intercept the EPIRB. The mate awoke Captain Anderson and briefed him on the situation. Mr. Nelson tried numerous times to hail the ARCTIC ROSE on VHF radio without success. The ALASKAN ROSE was

eleven miles due south of the EPIRB position. It took approximately one hour for the ALASKAN ROSE to arrive on-scene.

The Coast Guard diverted the Coast Guard cutters POLAR SEA and BOUTWELL to assist in the SAR case. The cutters arrived on-scene approximately 24 and 36 hours later respectively and conducted a search until the case was suspended on April 5, 2001.

The ALASKAN ROSE entered a debris field and the crew spotted a person in the water in a properly donned immersion suit. The rescuers recognized the person in the water as Captain Rundall and attempted to hail him but he was unresponsive to their calls. Mr. Nelson donned an immersion suit tethered to a safety line and entered the sea to rescue Captain Rundall. Mr. Nelson swam to the end of the safety tether but was unable to reach Captain Rundall. Mr. Nelson unhooked himself from the safety tether and swam the remaining distance to Captain Rundall. He grasped Captain Rundall and returned to the ALASKAN ROSE. Once he was within range, the crew on deck tossed a ring buoy to Mr. Nelson, which he grabbed and they pulled him safely alongside the vessel. The crew hoisted both men aboard the ALASKAN ROSE and began administering CPR to Captain Rundall. The Captain's immersion suit was full of water. He was fully clothed and wearing boots. Several large cuts were made in the suit by crew of the ALASKAN ROSE during the recovery of the Captain's body in an effort to provide emergency medical treatment. Therefore, it cannot be determined how water entered the suit. His body was subsequently taken into custody by the Dutch Harbor police department and transported to the Alaska State Medical Examiner in Anchorage for autopsy. The autopsy revealed that Mr. Rundall's cause of death was salt water drowning; a toxicology screen showed no evidence of alcohol or drug use. During their thirty-six hour search for survivors, the crew of ALASKAN ROSE recovered seven immersion suits and several work vests from the debris field. The SAR C-130 spotted an inflatable liferaft and directed the ALASKAN ROSE to its position south of the debris field. Once on scene, the crew of ALASKAN ROSE found the inflatable liferaft right side up and empty and identified it as the one from the ARCTIC ROSE. Deteriorating weather conditions presented a hazard to the rescuers in their attempts to recover the raft. The C-130 aircraft commander directed the crew of the ALASKAN ROSE to destroy the liferaft and sink it, which they did by slicing holes into the floatation chambers.

Two ALASKAN ROSE crewmembers testified they had sighted a person in the water during their search effort. Based on the clothing descriptions provided, two different individuals were sighted. One was wearing a white shirt with dark pants and the other was wearing a dark jacket or shirt with dark pants. The Marine Board believes, based on testimony of the sightings, ARCTIC ROSE watch rotations, and photographic evidence provided by family members, that Mr. G. W. Kandris was one of the individuals sighted. Both bodies slipped beneath the water before they could be rescued.

8. OWNERS AND OPERATORS

Arctic Rose LLC, a Washington state limited liability corporation formed in March 1999, owned the ARCTIC ROSE. The officers of the corporation are as follows: President – David Olney; Vice President – Ann Olney; Secretary/Treasurer – David Olney; and Vice President – John Casperson. The company is a subsidiary of Arctic Sole Seafoods Incorporated also owned by

David Olney. There were no management agreements with other corporations. Mr. Olney manages the day-to-day operations of the company.

The ARCTIC ROSE was operated as a H & G catcher processor. It harvested and processed a variety of non-regulated bottom fish year round primarily in the Bering Sea and the Gulf of Alaska. The vessel operated at varying levels of productivity during the year depending on the availability of fish resources. The bottom fish were harvested, headed and gutted, frozen, packaged, stored and transshipped for delivery to Japanese and U.S. markets.

Arctic Sole Seafoods is a charter member of Groundfish Forum. Mr. Olney was a driving force in the creation of this trade association to develop manageable solutions to bottom fish issues such as bycatch, incidental catches, and impact on habitat. The Groundfish Forum also lobbies state and local government officials regarding the contributions of the H & G fleet to the economies of Alaska and the Pacific Northwest. The Groundfish Forum represents nine trawl companies that own the majority of the H & G vessels in the North Pacific. These vessels target bottom fish that are non-IFQ'ed species such as rock sole, yellow fin sole, flathead sole, Atka mackerel, and Pacific cod in the Bering Sea and Gulf of Alaska.

9. ALCOHOL AND DRUG POLICY

The company's written policy required a negative pre-employment drug screening as a prerequisite condition for employment. Testimony from ex-crewmembers indicates this company policy was routinely overlooked when the vessel was prepared to go to sea and vacancies were filled with last minute hires. Alcohol was not permitted on board the vessel.

10. CREW HIRING PRACTICES

The ARCTIC ROSE and ex-TENACITY had a history to attract and an inability to retain quality workers. Testimony provided to the Marine Board by Ms. Ann-Marie Todd, a SCANSEA HR personnel manager, indicated that experienced processors were able to quickly assess the vessel's production capability by analyzing the size of the cargo hold and number of plate freezers and came to the realization that they would not make much money while working aboard the ARCTIC ROSE. The ARCTIC ROSE had a limited processing capacity with three plate freezers capable of processing five tons of fish, a limited storage capacity of 175,000 lbs, and tight living arrangements. This necessitated the need to hire persons new to the industry and unfamiliar with catch/processing rates. The exception to this trend was Captain Rundall, who spent eighteen months aboard the vessel.

Arctic Rose, LLC hired crew by word of mouth and through several maritime employment agents. A prospective crewman completed an employment application and signed a contract stipulating the terms of employment. The company did, on occasion, hire individuals off the street or dock to fill last minute vacancies.

11. HISTORY OF VESSEL REPAIRS, MODIFICATIONS AND SURVEYS

a. Shrimp Boat. The ARCTIC ROSE was originally constructed at Covacevich Boat Works in Biloxi, Mississippi by Mr. John Van Nguyen as a gulf shrimper and named SEA POWER. Due to a lack of plans it is unknown what construction methods were employed and it is unknown as to whether the vessel was constructed in accordance with a recognized standard.

Figure 12
Photo of SEA POWER (1990)

b. Scallop Boat. Information regarding the vessel's initial operations is sketchy. In the early 1990s, the vessel was modified to dredge for scallops and home ported in New Bedford, Massachusetts. There are no known drawings or plans to reflect this modification. Pictures taken by a marine surveyor show heavy doubler plates on the port and starboard sides and stern were installed with plug welds, most likely to protect the sideshell when the scallop dredge banged against those portions of the hull.

c. Catcher-Processor Boat – Second Owner and Operator. In 1991, Dr. Kusum and Dr. D.K. Stokes (North American Seafoods) purchased the SEA POWER. That year the vessel was modified to work in the H & G and freeze industry at SEA-FAB Inc., in Pascagoula, Mississippi. A shelter deck was extended aft from the house on the main deck (above the waterline) and consumed approximately two thirds of the aft working deck. This new space was equipped with fish processing equipment. A gantry and net reel was added at the stern for trawl operations. The existing live fish hold was converted to a cargo hold. The cargo hold was insulated with a spray-on urethane foam and equipped with a refrigeration system. A concrete deck was poured to level the deck and serve as insulation from the shaft alley that runs through the cargo hold. Mr. Bruce Culver, Naval Architect, reviewed the changes and conducted an inclining experiment on December 11, 1991 once the majority of work was complete. Mr. Culver issued a stability book to the owner, which incorporated the processing space as part of the vessel's watertight envelope. As such, the processing space was required to be weathertight whenever the vessel was underway. The vessel departed Pascagoula to work off the Oregon/Washington coast and transited to India for a brief period to engage in trawling operations. After the failed India excursion, the vessel operated in the Gulf of Alaska and Bering Sea waters.

Figure 13
Port view of TENACITY (1996)
Note addition of processing space on main deck.

d. Same Owner, New Operator. In 1995, the vessel's day to day management was assumed by SCANSEA Inc., from North American Fish Company at the owner's request. SCANSEA renamed the vessel changing it to TENACITY and continued to operate in the GOA and Bering Sea as a H & G processor. The vessel was plagued with engine, shaft and trawl equipment problems that led to North American Fish Company filing for bankruptcy in 1996. At that time, the TENACITY was taken out of service and moored at Fisherman's Terminal in Seattle, Washington. The vessel remained in lay-up status for over two years.

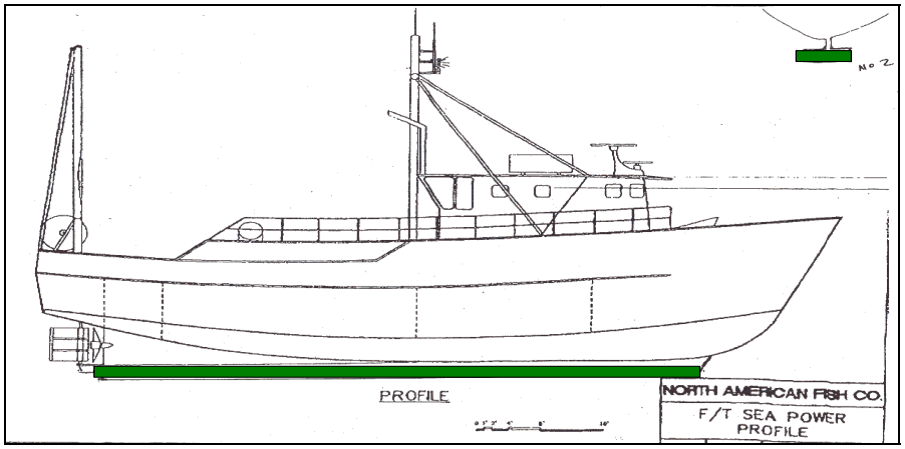


Figure 14
Profile drawing showing location of keel shoe (shaded green) on ARCTIC ROSE

Green shaded area represents the keel shoe and is not to scale.

e. Third Owner, Additional Modifications. The TENACITY was purchased by Arctic Rose LLC in March of 1999 and changed its name to the ARCTIC ROSE on June 25, 1999. In May 1999, the vessel was moved from Tippet Marine shipyard's waterside facility to the marine railway at Marine Fluid Systems in Seattle, Washington where a 13,600 lb keel shoe was welded to the exterior of the vessel. The old gantry was removed and a new larger "A" frame gantry was installed. Six inch pipe guards were installed on the upper deck to center the trawl net. A Cummins generator was installed in the engine room. A refurbished propeller and intermediate shaft were machined and installed. The original shafts were removed by SCANSEA personnel and could not be located.

Figure 15
Photo of "A" frame gantry (2001)

The existing stability vanes (see Figure 16), were removed.

Figure 16
Photo of "Stability Vanes (1995)

The processing space (See Figure 4) received a complete overhaul with all old equipment removed except for 2 plate freezers. The following new stainless steel equipment was installed: packing table with 2 Marel scales, wash tanks with incline conveyor, break tank gutting belt heading machine, bleeding bins, bleeding bin conveyor with incline conveyor, sorting belt with incline conveyors, dump box with incline conveyor and hydraulic sliding hatch, bleeding bins with three hydraulic doors. Tsurimi and Vaughn sump pumps were installed respectively on the port and starboard sides of the processing space. The deck of the processing space had steel framing and new fiberglass grating installed throughout. This grating was at a minimum of five inches off the floor. The by-catch and waste overboard discharge chutes were raised to four feet and five feet above the deck respectively. Both overboard chutes were fitted with closures. The by-catch chute was fitted with a manual guillotine type closure and the waste discharge chute was fitted with a flopper door. During the fall of 2000, the Cummins MDE was replaced with a Luger 6170. A Maxim model J10 water maker and Mitshubishi centrifuge diesel purifying system were installed in the auxiliary machinery space. The refrigeration system was completely overhauled. The

Figure 17
Photo of plate freezer similar to those aboard ARCTIC ROSE (2001)

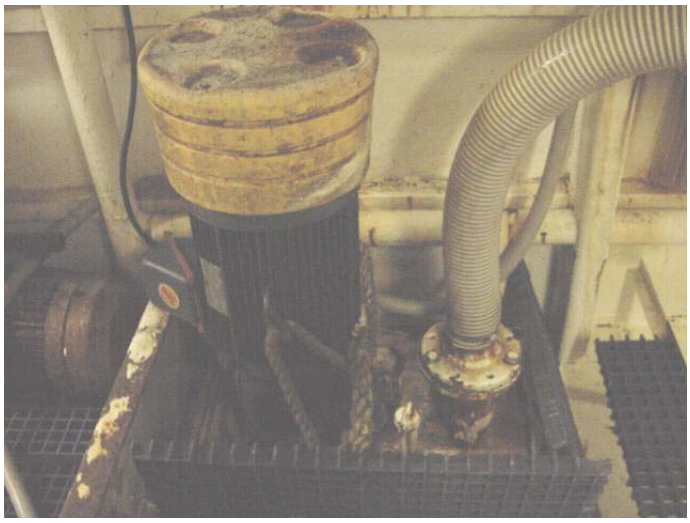


Figure 18
Photo of sump pump similar to those aboard the ARCTIC ROSE (2001)

port and starboard freon accumulator tanks and associated piping were removed from the weather deck, as was the accumulator tank in the auxiliary machinery space. Two new 8' x 4' low side receivers and associated piping and control panels were installed in the auxiliary machinery space. The processing space received a Jackson 100 pan plate freezer, for a total of three pan plate freezers in this space. To accommodate the new freezer, a Dole 96 pan plate freezer was moved several feet to the starboard side. Associated piping was modified to accommodate this new installation.

12. UNALASKA OPERATIONS

The ARCTIC ROSE predominantly operated out of Unalaska, delivering product to Offshore Systems Incorporated in Captains Bay or to trampers anchored in Captains Bay. Neither Arctic Sole Seafoods Incorporated or Arctic Rose LLC maintained an office in Unalaska. Cargo brokers and ship chandlers were contracted to move their cargo and provide supplies. Only minor or emergency repairs were conducted in Unalaska/Dutch Harbor and the company utilized the numerous vendors in Unalaska/Dutch Harbor to make repairs as needed.

13. FEDERAL REGULATIONS AND OVERSIGHT

a. United States Coast Guard. The USCG enforces many laws and regulations that apply to commercial fishing vessels and their safety. A majority of the regulations are contained in Title 46, CFR Subchapter C, Uninspected Vessels. The safety regulations specifically for commercial fishing vessels are contained in Part 28, which is divided into seven Subparts A-G. The applicability of these subparts to a fishing vessel is based on their area of operation in regards to the boundary line, the number of persons on board and the type of operation performed on board (H & G vs. processor). Additional regulations governing safe navigation, pollution and prevention are found in Title 33, Parts 88, 151, and 155 respectively. Title 46 CFR Part 16 contains the chemical testing regulations for commercial vessel operations.

The ARCTIC ROSE employed water in sorting and processing of fish, and as such was required to have an interlock installed to prevent the inadvertent flooding of the processing

space due to excess water. The Marine Board received testimony from several witnesses stating on several occasions the processing water was either left on, or the pumps in the processing space were plugged with debris, allowing the processing space to flood with processing water. This testimony raises the concern that the interlock system aboard the ARCTIC ROSE was either non-existent or non-functional.

b. Federal Communications Commission. There are few FCC regulations that apply to commercial fishing vessels. A majority of the regulations contained in 47 CFR 80.405 require a radio operator to hold a license and the radio station to be licensed.

   Vessels must comply with the regulations found in 33 CFR Part 26, which require all self propelled vessels over 20 meters (65.6 feet) in length to have a radiotelephone capable of operation from the navigation bridge, and capable of transmitting and receiving on the frequencies within the 156-162 MHz band using the classes of emissions designated by the FCC for the exchange of navigational information. Furthermore, the regulations found in 46 CFR Part 28.245 provide equipment and installation requirements.

c. National Marine Fisheries Service. NMFS is charged with the preservation of the biomass. 50 CFR 679.50 requires a NMFS observer aboard fishing vessels to monitor and analyze biomass caught by fishing vessels. The regulations delineate when a fishing vessel must carry an observer. The observers sample and log all species caught. Fishing vessels required to have observer coverage under 50 CFR 679.50(f)(1)(ii)(B) must have either a valid CG or recognized third party issued CFVSE decal, or a COC issued by a certified third party/organization. If a NMFS observer boards a vessel and it does not have a valid decal onboard, the observer must depart the vessel until it is in full compliance with the safety regulations and possesses a valid decal.

d. Occupational Safety and Health Administration. The OSHA standards for work place safety that are applicable to uninspected commercial fishing vessels are found in Title 29 CFR Parts 1910, 1915 and 1918. OSHA regulations apply to uninspected commercial fishing vessels when the vessel carries ten or more persons.

e. Applicability to the ARCTIC ROSE. The following regulations found in 46 CFR Part 28 applied: Subparts: A – General Provisions, B – Requirements for all vessels; and C – Requirements for documented vessels that operate beyond the boundary lines or with more than sixteen individuals on board, or for fish tender vessel engaged in the Aleutian Trade.

   The ARCTIC ROSE was required to meet the requirements found in 47 CFR Part 80.405 and 33 CFR Part 26 for its communications equipment.

   The ARCTIC ROSE was required to carry a part time NMFS observer and was required to have a valid CFVSE decal or equivalent prior to an observer boarding the vessel by 50 CFR Part 679.50.

   The ARCTIC ROSE routinely carried a crew complement of more than ten persons; therefore, OSHA regulations found in 29 CFR Parts 1910, 1915 and 1918 applied, but only when the vessel was operating within the territorial seas.

14. INDUSTRY STANDARDS AND GUIDELINES

The following is a list of the standards applicable to commercial fishing vessels:

- NVIC 4-82: Uninspected Commercial Vessel Safety
- NVIC 1-83: Painters for Life Floats and Buoyant Apparatus
- NVIC 12-83: Intact Stability of Towing and Fishing Vessels; Research Results
- NVIC 4-86: Hydraulic Release Units for Life Rafts, Life Floats and Buoyant Apparatus, and Alternate Float-Free Arrangements
- NVIC 5-86: Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels
- NVIC 6-91: Fire Drills and On-Board Training
- NVIC 7-91: Determination of Cold Water Areas
- NVIC 12-91: Termination of Unsafe Operations Aboard Commercial Fishing Industry Vessels
- NVIC 1-92: Lifesaving Equipment Regulations for Commercial Fishing Vessels
- NVIC 1-92: CH-1: Implementation of Lifesaving Equipment Regulations for Commercial Fishing Vessels
- NVIC 1-92: CH-2: Implementation of Lifesaving Equipment Regulations for Commercial Fishing Vessels
- NVIC 7-93: Guidelines for Acceptance of "Fishing Vessel Safety Instructors" and Course Curricula for Training "Fishing Vessel Drill Conductors"

15. WEATHER

The reported weather at the time of the casualty was:

Winds:	20 Knots
Direction:	090°T
Wave Height:	6-8 Feet
Seas:	Same
Swell:	Unknown
Prevailing Conditions:	Overcast Rain
Ambient Temp:	35°F
Water Temp:	34°F
Pressure:	995 millibars

Tendency:	Falling
Icing:	None
Forecast:	Valid from 0500 Sunday, April 1, 2001, to 0500 on Monday, April 2, 2001, Gale Warning, east wind 25-35, increasing to east and northeast 35-45 knots Sunday night, and seas 10-16 feet building to 16-24 feet by Monday.

This forecast was revised using the 176° W longitude line as the boundary separating the two for the new forecast zones. East of the 176° longitude line a new forecast was issued at 2000 Sunday, April 1, 2001 valid through 1700 April 2, 2001 predicting a Gale Warning with southeast winds increasing to 45 knots, and seas 15 - 20 feet.

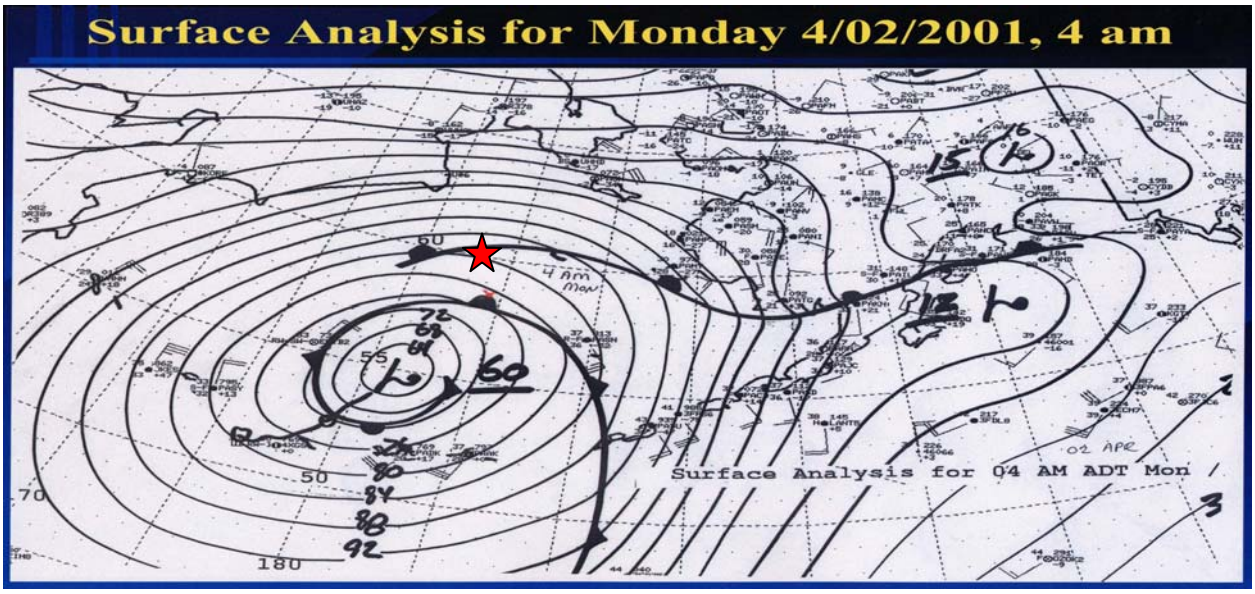


Figure 19
National Weather Service Surface Analysis for 4am April 2, 2001
The red star marks the approximate position of the ARCTIC ROSE

The generated forecast by the NWS covers a large area and unfortunately leads to ambiguous forecasts. This is due to the lack of data buoys and weather stations in the Bering Sea region. The NWS attempts to compensate for the lack of information by generating forecasts which tend to be conservative in nature. Many times these forecasts call for more severe weather than actually occurs and as a result the fishermen do not always trust these forecasts.

The NWS generated a hindcast (Figure 20) of the weather in the vicinity of the sinking based on weather reports from Coast Guard and other commercial sources operating in the vicinity of the sinking. Their analysis indicates a significant weather event occurred at the ARCTIC ROSE's last known position. A weather phenomenon known as a Triple Point, which is an area of a frontal system where a cold, warm and occluded front join together and is usually associated with severe weather, passed over the ARCTIC ROSE's position. It is highly probable, based on the Triple Point, the vessel experienced three distinct weather patterns within a brief period of

time. It is very likely the weather picture was further complicated by the development of micro-weather, another phenomenon where localized severe weather conditions can be experienced briefly and not experienced by other vessels nearby. This condition would also produce confused seas, making it extremely difficult for the operator/watchstander to predict wave heights and patterns.

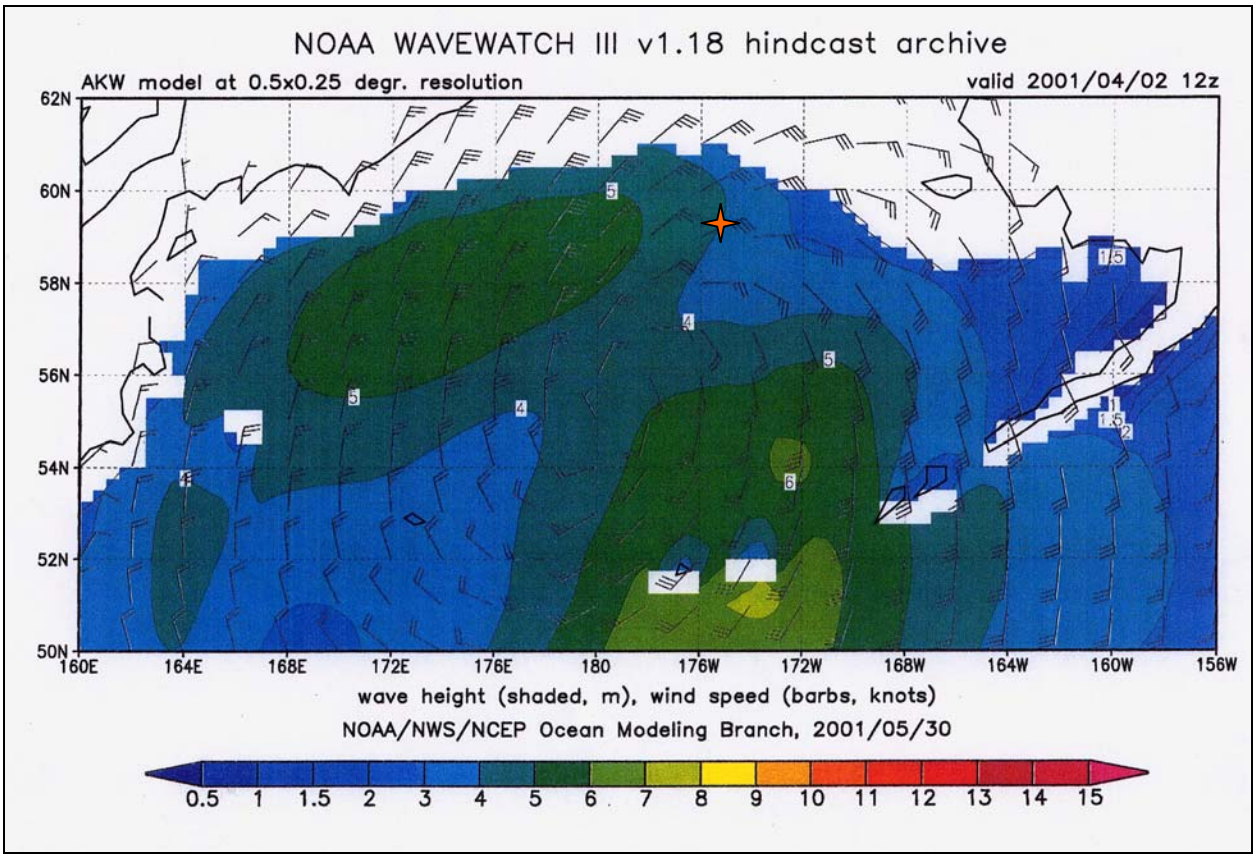


Figure 20
National Weather Service Hindcast for 4am April 2, 2001.
The orange star is the approximate position of the ARCTIC

The NWS hindcast shows the weather was worse than forecasted. In testimony provided to the Marine Board, Dr. Robert Hopkins of the NWS indicated that waves could reach significant heights of 24 feet and could be accompanied by sustained winds of up to 45 knots.

Mr. John Nelson, mate of the ALASKAN ROSE, provided testimony to the Marine Board that he experienced a significant wind shift between 2000 and 2400 on April 1st. He further stated the weather "flared up a bit" but then settled down. This wind shift is indicative of a frontal passage.

16. COMMUNICATIONS

Coast Guard COMSTA Kodiak maintains a live twenty-four hour watch. The COMSTA is responsible for monitoring all HF communications for the North Pacific region, which includes the area where the ARCTIC ROSE sank. Communication monitoring equipment is located on Kodiak Island and St. Paul Island. COMSTA Kodiak remotely monitors the St. Paul equipment. The COMSTA monitors 2182 KHz, 4125 KHz, and 6200 KHz distress frequencies from Kodiak. The COMSTA remotely monitors 4125 KHz at the St. Paul Island site. The Bering Sea does not have VHF repeater coverage; only line of site VHF communications is possible.

A HF propagation report, which is an indicator of the likelihood of successful communications, for a 24-hour period was prepared by CWO Kimmel of COMSTA for the period from 1600 on April 1, 2001 to 1600 on April 2, 2001. The interpretation of the 4125 KHz frequency propagation report shows a six hour window, 0100 to 0700 on April 2, 2001, of the 24 hour period when COMSTA Kodiak would have been able to communicate with the area of the Bering Sea where the EPRIB from the ARCTIC ROSE transmitted. It was estimated there was an eighty percent probability that COMSTA Kodiak would have heard a radio MAYDAY from the EPRIB's position. CWO Kimmel added that given the location of the EPRIB, there is a good chance that ALASKAN ROSE was outside of the St. Paul Island HF antenna "skip zone" and would have heard HF communications. HF communications are restricted by the characteristics of the ground and sky waves. Ground waves are low energy waves that can cover only a short distance over ground and sky waves are high energy, traveling great distances as they bounce off the earth’s surface and the ionosphere. Normally, close-in communications are restricted by a phenomenon known as the skip zone which exists between where the ground wave ends and the first skywave comes in. The extent of the skip zone varies in area depending on frequency, location, season and time of day.

CWO Kimmel provided testimony based on his seventeen years of experience with communications in Alaska and the Bering Sea region and the HF probability report, that had a MAYDAY been transmitted on 4125 KHz within that 6 hour period, it would have been heard somewhere in the world. CWO Kimmel classified HF communications for the stated period as "open" and stated he heard broadcasts from Australia and Mississippi that evening. The HF propagation report is located in appendix 2 of this report.

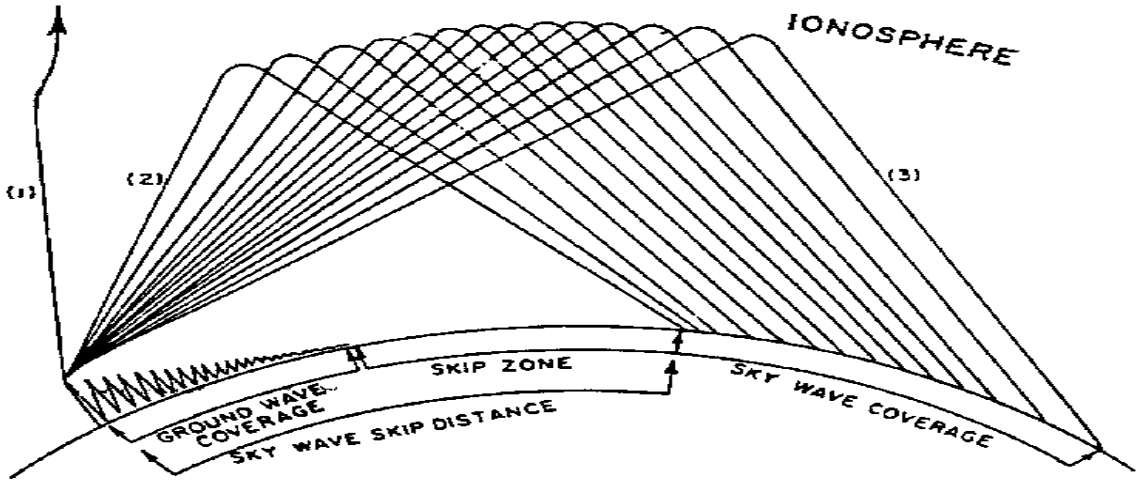


Figure 21
Graphic depiction of a Skip Zone

HF equipment typically does not have the dual watch capabilities that some VHF-FM radios have. Some VHF-FM radios have multiple transceivers or the ability to rapidly scan channels. This feature on VHF radios has allowed some vessels to pick up distress calls. HF equipment can be modified for dual watch capability by installing additional transceivers and antennas on board. However, a rapid scan of HF channels is not practicable due to the excessive static or noise associated with HF.

The CG monitors VHF-FM communications at AIRSTA Kodiak and repeater sites at Kodiak. VHF communications require line of sight to maintain or establish communications and the height of VHF antennas and the strength of the transceivers installed are the determining factors for the distance at which communications can be received. The mate on the ALASKAN ROSE stated normal distances for VHF communications from the vessel are eight to ten miles depending on the sea state.

17. SAFETYNET

a. System Description. SafetyNET is an internationally adopted, semi-automated satellite service designed for the promulgation of Maritime Safety Information (MSI) to all types of vessels. SafetyNET broadcasts are made over the INMARSAT-C system of geo-stationary satellites and are free of charge.

SafetyNET is a part of the Global Maritime Distress and Safety System (GMDSS). The GMDSS provides for automatic distress alerting in cases where a radio operator does not have time to send an SOS or MAYDAY call and, for the first time, requires ships to receive broadcasts of maritime safety information. If the INMARSAT-C satellite terminal is connected to a GPS or similar navigational receiver, or the ship's position has been recently updated manually, the vessel's position will be transmitted as part of the automatic distress alert. Specific radio carriage requirements depend upon the ship's area of operation, rather

than its tonnage. The system also provides redundant means of distress alerting, and emergency sources of power.

United States SafetyNET broadcasts include:

- Navigational warning broadcasts from the U.S. National Imagery and Mapping Agency
- Meteorological forecasts and warnings from the U.S. National Weather Service
- Distress alerts and search and rescue warnings from the U.S. Coast Guard
- Atlantic ice reports from the International Ice Patrol, U.S. Coast Guard

b. SafetyNET Services. Virtually all navigable waters of the world are covered by INMARSAT satellites. Each satellite transmits Enhanced Group Call (EGC) traffic (including SafetyNET) on a designated channel at 1.5 GHz. Any ship sailing within the coverage area of an INMARSAT satellite will be able to receive all SafetyNET messages broadcast over this channel by that satellite. All INMARSAT-C maritime ship stations can monitor the EGC channel. The EGC channel can also be monitored by dedicated receive-only equipment installed separately or as part of an INMARSAT A station. (INMARSAT A is voice and data transmission system whereas INMARSAT C is a data transmissions system only.) USCG SafetyNET messages are broadcast via Telenor Satellite Services, Inc. (formerly COMSAT), a commercial satellite service provider.

SafetyNET messages have five parameters: message priority, service code, address code, repetition code, and presentation code. The International SafetyNET Manual provides guidelines on the use of these parameters for SAR messages.

The designation of priorities in the SafetyNET system determines the order in which a message is broadcast. INMARSAT-C is a store and forward system where messages of higher priority are placed at the head of the queue for broadcast. The two highest priorities, Distress and Urgent, also set off the alarms of certain shipboard INMARSAT-C terminals, notifying the mariner that a high priority message had been received.

The address code allows messages to be sent to a circular or rectangular area. The ship's INMARSAT-C satellite terminal filters all the messages received from the satellite based on the ship's position, entered manually or via navigational receiver. Messages are only displayed/printed if addressed to an area containing the vessel's position. If the terminal is not connected to a navigational receiver, or the position is not updated, then it will display/print all messages broadcast over the satellite. Ships will receive all messages addressed to a NAVAREA if the user has entered the NAVAREA number into the terminal.

c. USCG SafetyNET Broadcasts. U.S. Coast Guard Rescue Coordination Centers (RCCs) disseminate and monitor SAR distress related information using the INMARSAT SafetyNET system when the SAR case location is deemed to be outside the coverage of NAVTEX. In general, NAVTEX coverage extends to 200 NM off the coast. NAVTEX coverage in Alaska is limited by the length and characteristics of the coastline.

d. SafetyNET Receivers. There are two types of INMARSAT-C systems sold for use aboard ship: a GMDSS version, and a non-GMDSS version, commonly referred to as the fisheries version. The two versions are very similar and provide similar features. However, with the non-GMDSS version, messages and safety broadcasts are often received and stored internally, without any notification to the operator that a message has been received.

Both the ARCTIC ROSE and ALASKAN ROSE had the non-GMDSS systems installed in the pilothouse. The non-GMDSS station is capable of transmitting distress calls but does not necessarily comply with the technical requirements of IMO. The vessels were not required by regulation to have GMDSS compliant equipment installed.

Although reception of SafetyNET traffic is automatic, the shipboard operator must set up the receiver properly at the start of the voyage, which includes the following steps:

1. Select the appropriate broadcast channel. This can often be accomplished by logging on to a land earth station in the ocean region for which needed broadcasts are made.

2. Select the NAVAREA identification code.

3. If traveling near Australia, select the proper coastal area codes.

4. Ensure the INMARSAT-C station is connected to a working navigational receiver. If a connection cannot be made, the ship's position must be manually updated every four hours during the ship's voyage. Without these updates, reams of unnecessary broadcast messages will be received.

Most INMARSAT-C terminals will not receive a safety broadcast if it is transmitting a message, or if it is tuned to an INMARSAT ocean region not used for safety broadcasts in the area traveled. Most SafetyNET messages are rebroadcast after six minutes, to give a transmitting terminal time to receive missed messages. Lists of SafetyNET broadcast schedules and areas have been published by the World Meteorological Organization to assist ship operators to tune INMARSAT-C terminals to the proper INMARSAT ocean region.

D17 CC Juneau issued a SafetyNET broadcast at 0429 on April 2, 2001, relaying the ARCTIC ROSE distress information with a service parameter of Navigational Warning and a priority parameter of Distress. Because of the configuration of Telenor's system prior to November 2001, the message defaulted to Safety Priority based on the service parameter. No documentation provided to the SafetyNET users at RCCs indicated that the priority of messages would be determined by the service parameter and they were unaware of the system's ability to default a message to a lower priority. Telenor's system was modified in November 2001 so that a message with any service parameter can be broadcast with any priority.

The INMARSAT-C system aboard the ALASKAN ROSE did not have an audible or visual alarm to notify the watchstander of an incoming urgent broadcast. The user would have to go from the steering station to the INMARSAT-C unit and download the messages. Each

message would have to be viewed prior to deleting it from the queue. The system operator has to program the INMARSAT-C system to receive messages based on the location of the terminal to avoid overloading the system with excessive messages from other broadcast stations. Mr. John Nelson provided testimony to the Marine Board indicating the ALASKAN ROSE did receive countless messages from Russia but did not receive the distress message until several hours after it was sent by D17 RCC.

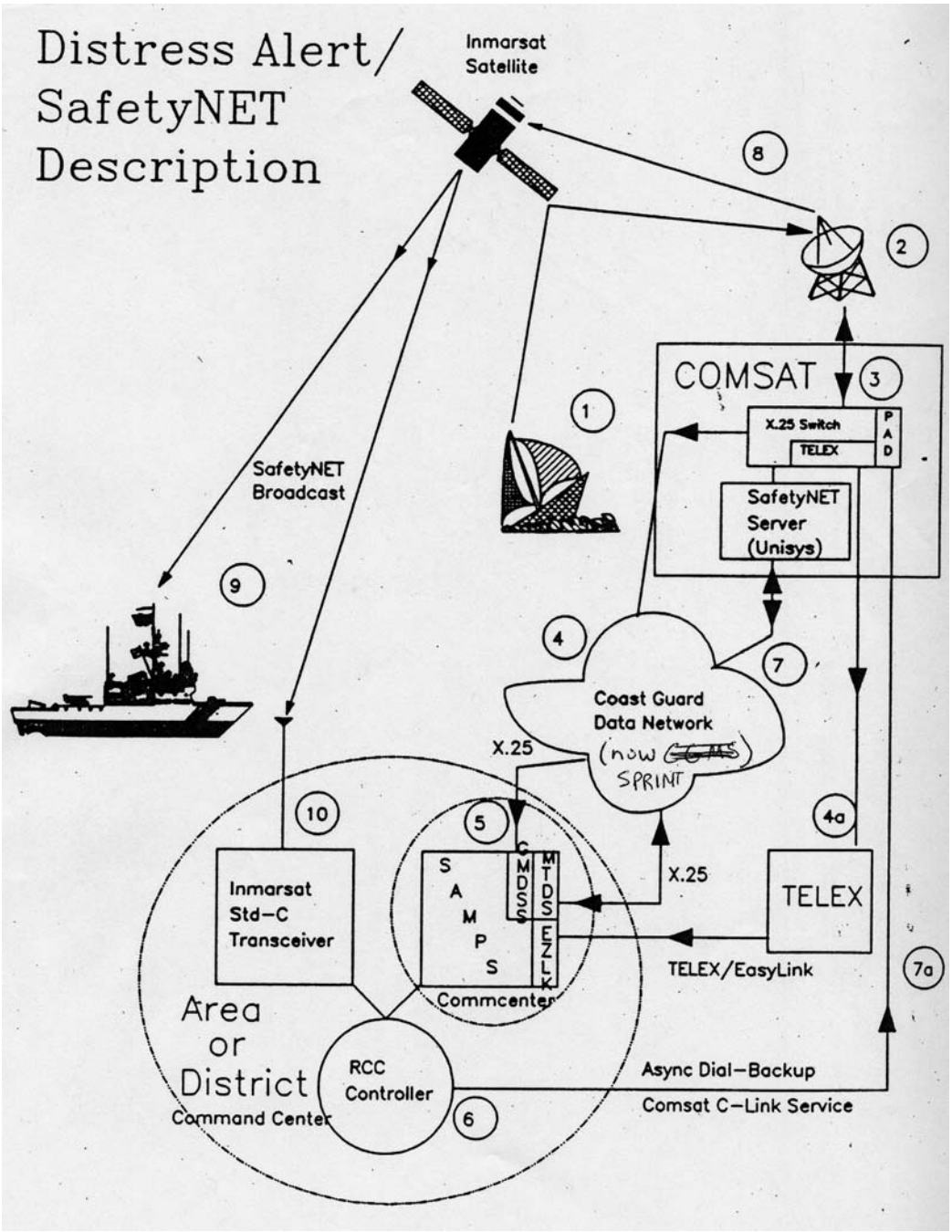


Figure 22
Diagram of SafetyNET Network

18. COMMERCIAL FISHING VESSEL SAFETY PROGRAM

Congress passed the Commercial Fishing Vessel Safety Act of 1988, which requires certain lifesaving equipment aboard commercial fishing vessels. The voluntary dockside exams were instituted as part of the CFVSA. The purpose of the Coast Guard's CFVSE program is to ensure that fishing vessels have the proper life saving equipment for the area of operation based on a number of factors such as vessel size, area of operation, etc. The CFVSE does not evaluate the vessel's structure, hull integrity, critical systems or crew competence. Therefore, the program focuses on emergency response by emphasizing emergency drills and safety equipment that will aid the mariner should a casualty occur. The Coast Guard instituted the voluntary dockside examination program through the promulgation of COMDINST 16711.13B, Implementation of the Commercial Fishing Industry Vessel Regulations, dated November 1, 1996. The instruction provides Coast Guard units with guidance to perform voluntary dockside exams.

a. Voluntary Dockside Exam Program. The ARCTIC ROSE had a voluntary dockside examination based on its operation as a H & G vice a fish processor, receiving a valid CFVSE decal (#74701). It was issued in Unalaska on September 9, 1999, by a Petty Officer from the Marine Safety Detachment. The Marine Safety Information System case number for the inspection is MI99030162.

   Marine Safety Office Anchorage pursues an aggressive prevention approach to the CFVSE program. The unit deploys CFVSE examiners and marine inspectors to fishing ports prior to the King and Opelio crab seasons and other high risk fishery openers. The examiners board the vessels prior to their departure to evaluate vessel stability and safety equipment. Using existing authority, the COTP prohibits a vessel's departure until noted safety deficiencies are corrected. MSO Anchorage's proactive enforcement has made a positive contribution to safety, recording no loss of life during these high risk fisheries from 1999 - 2001.

   MSO Anchorage also works in concert with the state of Alaska and NMFS observers. MSO personnel supplement the NMFS observer safety training course to provide the observers with basic safety skills and an overview of the CFVSE program. This interagency partnership facilitates the communication of safety issues that NMFS and State observers encounter while on board a fishing vessel to the Coast Guard. There has been concern expressed by NMFS personnel that this information is considered proprietary in nature and should not be passed to the Coast Guard. The Coast Guard is currently working with NMFS to address these concerns.

b. At Sea Boardings. All vessels, including commercial fishing vessels, are subject to at sea boardings by the Coast Guard. The Coast Guard's at sea boarding policy is outlined in ALDIST 062/92 and the MLEM Manual COMDTINST M16247.1. The ALDIST message provides guidance for the Coast Guard's cutters to perform at sea boardings and details the safety equipment the boarding team should focus on.

   The ARCTIC ROSE was boarded by a team from the USCGC STORIS (WMEC 38) on February 25, 2001, approximately 19.5 nautical miles off Otter Point, Alaska, in position 55°22.8N/163°52.4'W. The boarding team consisted of five members with LTjg Katherine Fox acting as the boarding team leader. The team introduced themselves to the Master,

Captain Rundall. Petty Officer Inglassias conducted an ISE and reported back to LTjg Fox that the vessel was free of safety hazards. Noting the vessel had a valid CFVSE decal, the boarding team checked the vessel's PFD's, Survival Craft, EPIRB, Ring Life Buoys, Lifesaving Equipment Markings, and Distress Signals. No deficiencies were noted and they departed the vessel.

c. Ready For Sea. The Seventeenth Coast Guard District's "Ready for Sea" program is an initiative started in 1999 to reduce the number of fishermen's lives and vessels lost at sea. This outreach effort is part of the D17 safety initiative to expand the focus on fishing vessel safety to include prevention of accidents. The "Ready For Sea" program is a voluntary dockside exam program. The "Top 10-Ready For Sea" checklist was produced after an in-depth study of the causal factors of fishing vessel casualties that occurred in Alaska from 1989 – 1999. Masters and crewmembers are encouraged to examine their vessel prior to getting underway and periodically while at sea paying particular attention to the ten issues on the checklist. Doing so will increase the likelihood of the crew and their vessel returning home safely. In addition to distributing a "Top 10-Ready for Sea" checklist, D17 also sends out Safety Alerts after fishing vessel accidents that contain a brief overview of the scenario and the lessons learned. Safety Alerts are designed to inform other fishermen on what went right and what went wrong. D17 is expanding its contact with the Alaska fishing community through voluntary dockside safety exams, training sessions and boardings at sea, with an emphasis on boarding vessels that do not have a current fishing vessel safety decal.

Testimony provided by Operations Officers of the USCGCs BOUTWELL (WHEC 719) and POLAR STAR (WAGB 10) indicate the cutters patrolling the Bering Sea, not permanently assigned to D17, are not conversant with the "Ready For Sea" Program.

19. TRAINING

a. U.S. Coast Guard. The Coast Guard conducts a one-week Commercial Fishing Vessel Examiner's Course at its Training Center in Yorktown, Virginia. There is no pre-requisite training for this entry level course, which provides Coast Guard personnel with the basic knowledge and skill set to examine commercial fishing vessels and issue decals. This course must be supplemented with on-the-job training. This training focuses on the examination of primary lifesaving and fire fighting equipment and their installation. It does not provide the student with any basic inspection/survey skills, which might allow the examiner to detect unsafe or hazardous conditions aboard a fishing vessel, such as poor watertight integrity, structural fire protection, etc.

The Coast Guard has regional fish schools located in Massachusetts, South Carolina, Louisiana, Alaska and California that train cutter boarding team members. The school in Kodiak, Alaska primarily focuses on fisheries enforcement but does have a four hour block of time for introductory fishing vessel safety training. The safety equipment training is provided by Commercial Fishing Vessel Examiners attached to the Marine Safety Detachment in Kodiak, Alaska.

b. Commercial Fishing Vessel Industry. The industry has attempted to implement a standardized training program on a regional basis. An example is the program developed by

the NPFVOA, which is considered by some to be the model training program in the country. Current regulations found in 46 CFR 28.270 require drills and safety training for crew. This "in house" training must be conducted by an individual who meets the regulatory requirements of having received basic training and skills on drill instruction. Processors are not required to have any basic or entry level safety training prior to accepting a job in the fishing industry. However, they should receive a safety orientation when they report aboard the vessel. The orientation must be provided by the master or individual in charge.

c. NMFS Observers. NMFS certified observers are provided through observer provider companies. The fishing vessel operating company must arrange for the observer coverage from the commercial providers. NMFS policy requires all observers to complete a basic safety/survival training course prior to working aboard a fishing vessel. They are also required to undergo a refresher course. NMFS provides for the training and certification of the observers. There are several companies providing observer coverage for the Alaska region. (see http://www.afsc.noaa.gov/refm/observers/observer_provider.htm) NMFS regulations found in 50 CFR 600.746 require all commercial fishing vessels carrying an observer to have a valid CFVSE decal.

d. ARCTIC ROSE. Testimony from several witnesses provided conflicting evidence regarding the level of safety training they received while aboard the ARCTIC ROSE. Arctic Sole Seafoods did have a company policy in its operations manual to address the frequency of safety training provided to its employees while aboard the ship. A NMFS observer testified that abandon ship drills were conducted on a weekly basis, characterizing them as good and further stated that the vessel orientation was the best she had received as an observer. Other ex-crewmembers stated the only safety training received was a brief introduction to the safety equipment aboard the vessel and a summary presentation on donning an immersion suit. Consequently, none of the processors working aboard the ARCTIC ROSE had any safety or survival training other than the shipboard introductory exposure to the location of survival gear and the donning of immersion suits.

A review of the ARCTIC ROSE crew list and NPFVOA course enrollment records reveal only Captain David Rundall had received both drill instructor and medical emergencies at sea training in August of 1997 while employed for Iquique US, Inc. While there are other sources of safety training, no other records pertaining to the crew were located. The ARCTIC ROSE crew was relatively inexperienced with the fishing industry. Nine of the unlicensed deck crew and processors had fished for less than a year or were on their first trip. Some individuals were hired just prior to the vessel's departure from Fisherman's Terminal in Seattle, Washington. The captain had the most experience, both in the commercial fishing industry and aboard the ARCTIC ROSE. While the mate, Mr. Egan, was not new to the industry, having sailed as mate on other fishing vessels in the Bering Sea, he joined the vessel in Dutch Harbor in late March and this was his first trip on the ARCTIC ROSE.

20. NMFS OBSERVER CONNECTION

The ARCTIC ROSE was required to have part time NMFS certified observer coverage. The ARCTIC ROSE was known as a 30% vessel because its overall length was greater than 60 but less than 125 feet. As such, it was required to carry a NMFS certified observer for 30% of its

time fishing in each calendar year. The most recent NMFS observer, Ms. Jennifer Eichelberger, departed the vessel on March 21, 2001. NMFS observers are required to complete a data and safety out brief with the Observer Program debriefing staff. Previous out briefs have identified safety concerns aboard the ARCTIC ROSE, which ranged from occupational safety items, work place safety and concern for vessel safety. This information was not provided to the Coast Guard at the time the out briefs were conducted. The observer concerns in regards to safety issues aboard the ARCTIC ROSE were the difficult egress path from the sampling station to the exits. Also, testimony provided to the Marine Board by Ms. Jennifer Eichelberger stated she could not conduct one required sampling of a catch due to excessive water in the processing space.

21. HEAD AND GUT OPERATIONS

The ARCTIC ROSE was engaged in “Head and Gut” operations. The processors remove the head (by hand or by guillotine) and entrails, then flash freeze the fish. Once frozen, the fish blocks are bagged and placed in the cargo hold for storage until they are offloaded ashore or to a tramper at anchor.

The H & G process does not meet the regulatory definition of processing and therefore, the ARCTIC ROSE was exempted from the Processing Vessel regulations found in 46 CFR Part 28 Subpart F. However, testimony by an ex-crew member, Mr. Rafael Olivaris, indicates that the vessel did indeed engage in fish processing by removing tails and fins and was subject to the regulations governing fish processing vessels. A vessel cannot arbitrarily change its status from non-processor operations, such as H & G, to processing. Once the ARCTIC ROSE engaged in processing, the regulations in 46 CFR Part 28, Subpart F applied. These regulations require a class society or other similarly qualified organization to conduct an examination of the vessel.

22. VESSEL STABILITY

The ARCTIC ROSE had a stability test conducted in 1991, after its conversion to the SEA POWER, by Mr. Bruce Culver. Mr. Culver generated a set of operating conditions for the vessel with the restriction that "These stability calculations assume the processing area is intact and watertight. If water accumulates in the processing area all fishing or processing operations must be halted until the water is cleared". In 1999, after the ARCTIC ROSE was purchased by Mr. David Olney, Jensen Marine Consultants, Inc. (JMC) was hired by the owner to generate a new stability booklet for the vessel. On March 31, 1999, Mr. Eric Blumhagen, P.E., of JMC performed an inclining experiment to calculate the lightship displacement and center of gravity for the vessel, then created operating limits for the vessel based on the stability criteria found in NVIC 5-86, titled, “Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels”. He provided testimony to the Marine Board regarding the inclining experiment. The test was conducted with only two weight movements vice the ASME standard of three weight movements. Mr. Blumhagen stated that this is normal practice for an uninspected fishing vessel to be treated differently from an inspected vessel. Independent review of the JMC stability files indicate a third weight movement would not have altered the outcome or changed the conditions in the stability letter. The stability booklet was signed by Mr. David Parrot, P.E. on July 9, 1999 and contained restrictions on freeboard, tank usage, and the amount of cargo carried on deck and underdeck. The operating instructions' second paragraph stated, "This stability letter is void

unless the processing space is kept weathertight at all times." Additionally in Section IX, Weather Tightness and Seaworthiness, the operating instructions required that, "All watertight doors shall be kept closed except when used for passage ... Doors for the scrap chutes and the fish chutes in the factory bulkheads should be kept closed at all times except when necessary to conduct processing operations. All side fittings that open to the factory must be fitted with a watertight closure and check valve."

There were a large number of weight additions, removals, and relocations performed on the ARCTIC ROSE between July 9, 1999, when the operating instructions were issued, and April 2, 2002. The stability calculations performed by JMC accounted for a 13,500 lb keel shoe (ballast bar) and approximately 20,000 lbs of boiler shot (boiler shot is a term used to describe round steel pieces approximately 1-2 inches in diameter) cement mixture, which was poured into the shaft alley area of the fish hold of the vessel after the inclining. Additionally, a plate freezer and new refrigeration equipment was added in the processing space, a water maker was installed, and other equipment was added to the vessel. Mr. Olney did not track any of the weight additions, relocations, and removals for the vessel. Finally, the owner did not contact a naval architect to evaluate the effect of the weight changes on the vessel's stability.

The ARCTIC ROSE was not in compliance with the operating instructions issued by JMC at the time of the casualty. As discovered during the second ROV survey, the aft starboard door in the processing space was open and the guillotine closure for the starboard discharge chute was 2/3 open, thus preventing the processing space from being weathertight. The fuel and water tanks were being used in the opposite order specified in the stability letter. A review of the ARCTIC ROSE stability booklet and testimony provided to the Marine Board from Mr. Parrott and Mr. Green of JMC indicate the consumption order of the wing tanks had a negligible effect on the vessel’s stability. The double bottom fuel tank was not pressed full at all times, but was instead being used as a day tank. Testimony provided to the Marine Board from Mr. Milosh Katurich, a chief engineer, indicated the double bottom fuel oil tank was used as a day tank and was refilled at the beginning of each day. There was between 9,500 and 12,000 gallons of fuel oil onboard the vessel and 53,000 lbs of product, stores and ballast in the fish hold at the time of the casualty. According to the deck loading table from the JMC stability booklet, the maximum deck load (which includes both processing and cod end loads) is 3,000 lbs. However, there was 10,000 lbs of deck load in the plate freezers at the time of the casualty. While independent calculations later found the vessel met the intact stability criteria, at the time of the accident, the master of the vessel only had use of the operating instructions to evaluate if his vessel met the minimum stability criteria.

STABILITY INFORMATION BOOKLET

VESSEL: F/V ARCTIC ROSE

PAGE 4 OF 7

JOB No. 99046

DECK LOADING TABLE

	A	B	C	D	E
TANKS	14,932 GAL	12,238 GAL	9,466 GAL	6,310 GAL	3,678 GAL
FODB1.C	98%	98%	98%	98%	98%
FOWING2.P/S	98%	50%	0%	0%	0%
FOWING3.P/S	98%	98%	98%	50%	0%

HOLD CARGO	BETWEEN A & B	BETWEEN B & C	BETWEEN C & D	BETWEEN D & E
0 POUNDS TO 25,000 POUNDS	DO NOT OPERATE	DO NOT OPERATE	DO NOT OPERATE	DO NOT OPERATE
25,000 POUNDS TO 50,000 POUNDS	5,000 POUNDS	DO NOT OPERATE	DO NOT OPERATE	DO NOT OPERATE
50,000 POUNDS TO 100,000 POUNDS	17,000 POUNDS	3,000 POUNDS	NO DECK LOAD	DO NOT OPERATE
100,000 POUNDS TO 150,000 POUNDS	22,000 POUNDS	15,000 POUNDS	15,000 POUNDS	8,000 POUNDS
150,000 POUNDS TO 175,000 POUNDS	21,000 POUNDS	13,000 POUNDS	13,000 POUNDS	8,000 POUNDS

Notes:
1. This deck loading table is subject to the restrictions listed in the attached "Operating Instructions".
2. Under icing conditions, reduce deck loads by 19,000 pounds. Do not operate where this reduction results in a negative deck load.
3. In the shaded conditions, freeboards may be less than 6", depending on deck and consumables loading. We recommend that loads be reduced to maintain 6" of freeboard.
4. Deck loads may not be carried on the shelter deck.
5. Allowable deck load includes both processing and codend loads.
6. Hold cargo weights include weight of any supplies or other gear carried in the freezer hold.

Figure 23
Deck Loading Table from ARCTIC ROSE Stability Booklet

The Marine Board received testimony from Mr. John Womack, a naval architect and member of Society of Naval Architects and Marine Engineers Ad Hoc Panel on Fishing Vessel Operations and Safety Working Group B indicating that the average commercial fisherman is not familiar with stability information. Furthermore, stability information is provided in a myriad of forms as there is no set industry standard. This creates an environment where stability information is presented to the mariner in a format that can be difficult to read and/or interpret. As a result, many fishermen determine the stability of their vessels by feel. The information on the ARCTIC ROSE was open to wide interpretation. A previous mate on the ARCTIC ROSE, Mr. Tom LaPointe, reviewed the JMC stability booklet and stated, "I think if I had this information and I had seen this particular stability book, I would not have gone on the ARCTIC ROSE."

The SNAME work group is promoting a format that presents stability information and operating guidelines in a color graphic which is easy to understand.

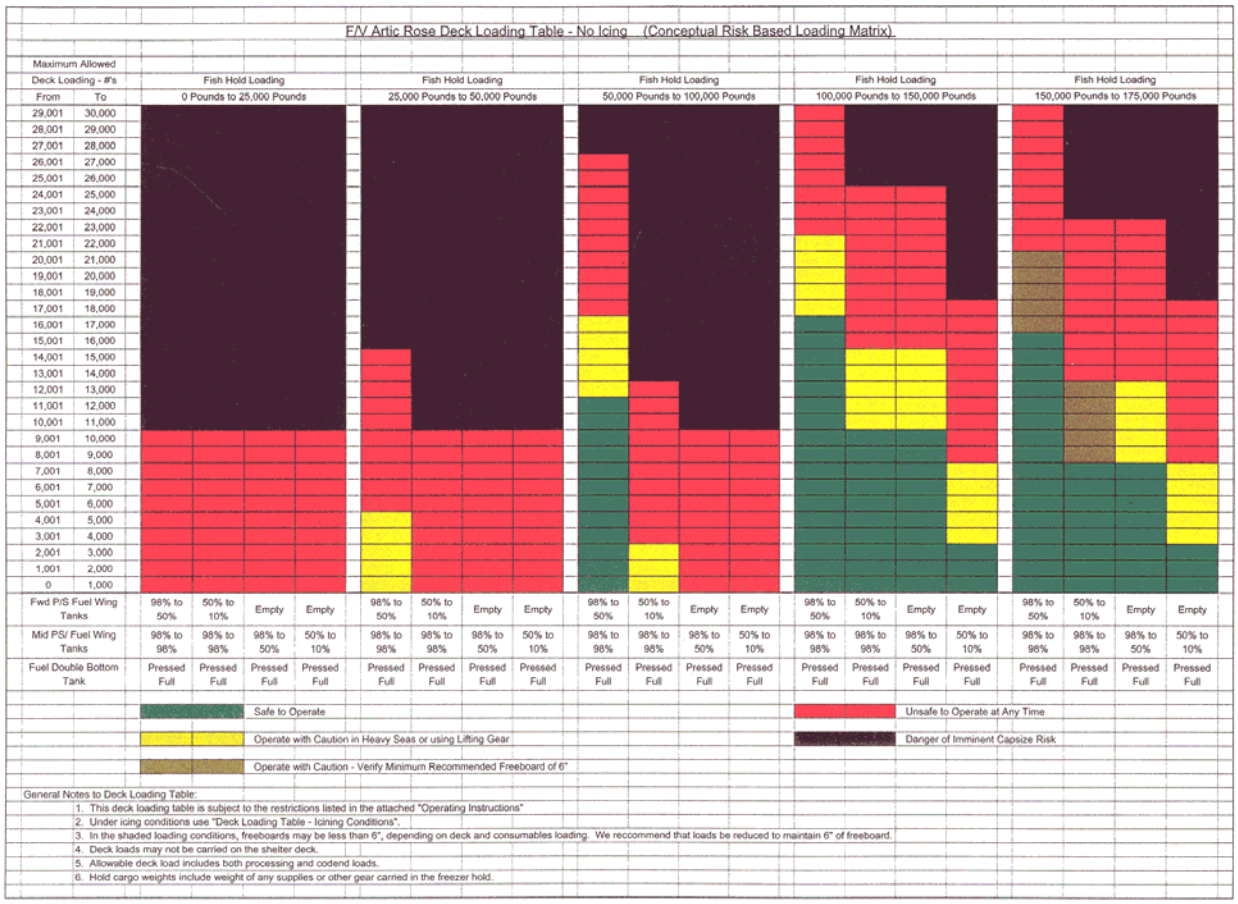


Figure 24
SNAME graphic stability chart

This format provides the vessel's operator and crew with a quick visual reference to make an informed decision for safe operations without having to perform stability calculations.

Mr. Olney testified to his belief of meeting the operating chart through the addition of weight with the keel shoe and boiler plate cement mixture. In fact, this is in error as these weights were accounted for in the JMC stability calculations.

23. REMOTE OPERATED VEHICLE (ROV) OPERATIONS

The Coast Guard undertook two separate expeditions to locate and survey the wreck of the ARCTIC ROSE. These expeditions proved critical to the Marine Board's investigation through the discovery of evidence and facts to determine the proximate cause of the casualty.

a. First Expedition. This expedition began in mid-July aboard the M/V OCEAN EXPLORER, which was on a charter by NMFS. The Marine Board, with the assistance of NMFS, extended a contract for the services of a KLEIN 5000 SONAR. An additional contract was obtained for the services of a Phantom HD2 ROV. The first task was to locate the wreck with sonar. The sonar technicians developed a grid plot by employing the data collected during the SAR case, which can be found in Annex C of this report. A large contact was located during the third pass over the search area. The team conducted several additional passes to determine the position of the vessel and size of debris field on the sea floor. At daybreak on July 18, 2001, the ROV equipped with a video camera was lowered into the

Figure 25
Photo of Klein 5000
side scanning sonar (2001)

Figure 26
Photo of Phantom HD2 ROV
(2001)

water. Shortly thereafter, the Board received its first look at the vessel, which was sitting upright on the sea floor in 73 1/3 fathoms, or 428 feet, of water in the location 58° 56.22 minutes North latitude and 175° 53.10 minutes West longitude. The location is approximately 200 miles northwest of St. Paul Island, Alaska. The ROV was maneuvered slowly up the port side of the hull and revealed the name – ARCTIC ROSE. The ROV

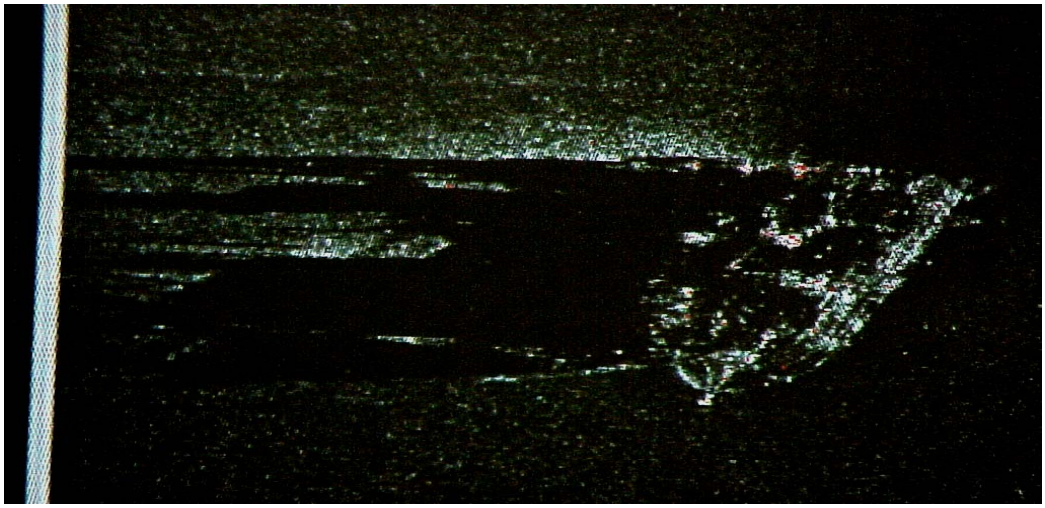


Figure 27
Picture from side scanning sonar of ARCTIC ROSE (2001)

made several passes along the port bow and port side of the pilothouse. Multicolored polypropylene lines used to mend the trawl net had unraveled from their cardboard spools and were floating above the wreck. As the ROV maneuvered around the wreck, several lines were sucked into the ROV's impellers and entangled it. Efforts to free the ROV resulted in the ROV's umbilical cord parting and the loss of the ROV.

Figure 28
Photo of
Arctic Rose
(2001)

b. Second Expedition. In mid-August 2001, the Marine Board contracted a larger and more powerful ROV. The MAXRover surveyed the wreck of the ARCTIC ROSE completing a

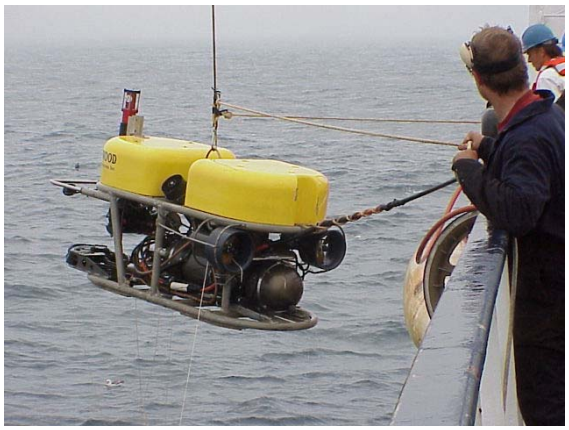


Figure 29
Photo of MAXRover deployed during second expedition (2001).

large majority of the work left unfinished by the first mission. The expedition video discovered many facts concerning the condition of the ARCTIC ROSE. The ROV surveyed a large majority of the hull above and below the waterline, port side of the pilothouse, and the aft deck area. The following was observed:

- The vessel's hull was intact.
- The vessel's pilothouse was undamaged with all windows visibly examined found intact.
- The aft weathertight door to the processing space from the trawl deck was open.
- The vessel's rudder was over to port.
- The trawl net was on the reel and the cod end was in the dump box.
- The trawl doors were missing.
- There was no evidence of fire or explosion to the vessel.
- The starboard overboard discharge chute was partially open.
- The wires were spooled on the trawl winches as indicated by the tattle tale marks.
- Trawl gear, mud lines and wires had shifted to the starboard side of the vessel.
- The vessel landed on the sea floor stern first as shown by the plow marks aft where the vessel's kort nozzle made its initial impact.

The information obtained during this expedition also clearly revealed that the vessel was not fishing at the time of the casualty.

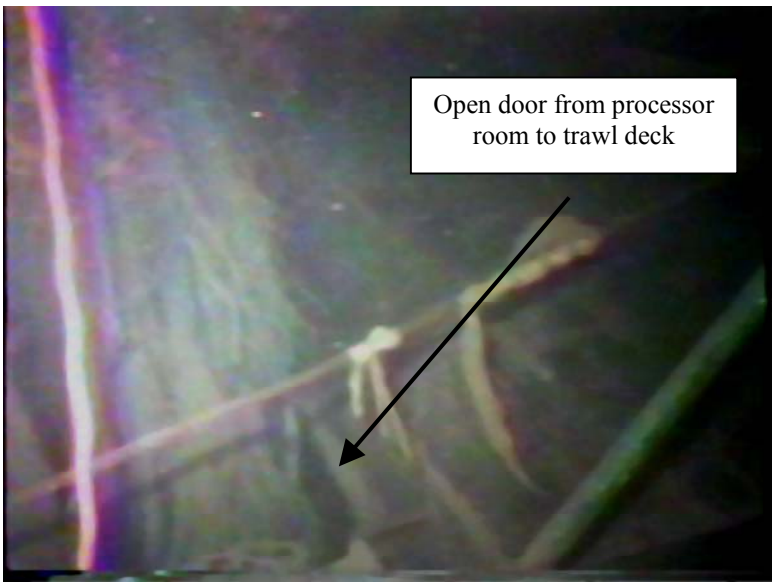


Figure 30
Photo of open weathertight door on aft bulkhead of processing space taken from ROV video (2001)

SUMMARY OF FACTS

1. The vessel was a 92.6 ft long fishing vessel operated as a H & G or processor at times.

2. The vessel's owner/operator was:
   Arctic Rose, LLC.
   3824 18th Ave., W
   Seattle, WA 98119

3. The master was Mr. David Rundall, and he held a valid Coast Guard license Master of Steam or Motor Vessels of Not More Than 1600 Gross Regulatory Tons Upon Oceans Route, No. 792863, Issue 1-3.

4. The vessel did operate as a processing vessel by the removal of tails and fins.

5. The vessel was subject to the requirements found in 46 CFR Subchapter C, including the requirements of 46 CFR Part 28, Subpart F, applicable to fish processing vessels.

6. The vessel had a stability test on March 31, 1999 conducted by JMC.

7. JMC provided the stability book and letter to the ARCTIC ROSE on July 9, 1999.

8. Cement and boiler shot, keel bar, third plate freezer, freon system and other smaller weights were added to the vessel after the inclining experiment was conducted.

9. JMC was not informed of all the weight changes with the exception of the cement and boiler shot and keel bar nor requested to recalculate the vessel's stability based on these weight changes.

10. The JMC stability letter required all weathertight and watertight doors to remain closed at all times, except when in use.

11. The JMC stability operating guidelines required the ARCTIC ROSE to have 25,000 lbs of cargo on board when all tanks were full or nearly full.

12. The JMC stability operating guidelines required the processing space to remain water-free at all times.

13. The ARCTIC ROSE's last port of call was St. Paul Island on March 30, 2001.

14. The ARCTIC ROSE had a crew of fifteen at the time of the sinking.

15. The body of the vessel's master, David Rundall was recovered. An autopsy revealed the cause of death to be salt water drowning with no evidence of drug or alcohol use.

16. Fourteen persons are missing and presumed dead.

17. Ten of the fifteen crew began working aboard the vessel on or after January 2001; most of the crew was inexperienced.

18. The vessel was engaged in the Flathead Sole B season, which opened on April 1, 2001.

19. The ARCTIC ROSE was fishing in the vicinity of the ALASKAN ROSE.

20. The last communication from the ARCTIC ROSE was at approximately 2230 on April 1, 2001, between Mr. John Nelson, mate of ALASKAN ROSE and Mr. Dave Rundall, Master of the ARCTIC ROSE.

21. The last visual sighting of the ARCTIC ROSE was at approximately 2200 on April 1, 2001, by Mr. John Nelson of the ALASKAN ROSE.

22. The last contact (radar) with the ARCTIC ROSE was at approximately 2359 on April 1, 2001, by Mr. John Nelson of the ALASKAN ROSE.

23. The ALASKAN ROSE reported a shift in wind direction between 2000 and 2359 on April 1, 2001.

24. Significant weather in the form of a Triple Point passed the immediate area of the ARCTIC ROSE at the time of the EPIRB alert.

25. Weather at the time of the casualty included waves with a significant height of 24 feet and sustained winds to 45 knots and an ambient air temp of 36°F.

26. Testimony by ALASKAN ROSE crewmembers established that the ARCTIC ROSE was jogging at the time of the sinking.

27. The ARCTIC ROSE was not fishing at night.

28. There were approximately 7.53 long tons of processed fish on board the vessel. Approximately 5.31 long tons of this weight was stored in the pan freezers in the processing space.

29. The aft weathertight door to the processing space was open.

30. The interior door to the mudroom and accommodations was open at the time of the incident.

31. The starboard overboard discharge chute was partially opened.

32. The pilothouse windows were intact.

33. There was no evidence of hull damage.

34. There was no evidence of storm damage.

35. There was no evidence of fire or explosion.

36. The trawl net was on the reel and the cod end was in the dump box.

37. All wires were spooled on winches as indicated by the tattle tale marks on the cables.

38. The mud line was hanging over the starboard bulwark.

39. The trawl doors were not in their normal stowage location and were not located.

40. The rudder was hard over to port.

41. The ARCTIC ROSE sank at or about 0325 on April 2, 2001.

42. The EPIRB deployed and functioned as designed.

43. The EPIRB was properly registered with NOAA.

44. The Coast Guard notified the owner of the ARCTIC ROSE of the EPIRB Alert.

45. The owner was unable to contact either the ARCTIC ROSE or the ALASKAN ROSE via e-mail or satellite phone.

46. CCGD17 Command Center sent a Distress Alert via SafetyNet.

47. The Coast Guard responded to the 406 EPIRB Alert by issuing UMIBs and mobilizing a SAR case with a C-130 fixed wing aircraft and two Coast Guard cutters to search for the ARCTIC ROSE.

48. The software developed by COMSAT lowered the priority of the Distress Alert. This reduction in status was unknown to the message sender.

49. The liferaft was spotted by the C-130 crew.

50. The liferaft was located and found fully inflated and in an upright condition.

51. The exposure suits were stowed in a wooden box on the weather deck located on the port side of the pilothouse.

52. Seven exposure suits out of their storage bags were recovered during the search.

53. Captain Rundall was recovered in an immersion suit full of water, deceased.

54. The vessel's ring buoys were never found.

55. The ARCTIC ROSE is sitting upright resting on its starboard chine in 428 ft of water located in position 58° 56’ 22” N / 175° 53’ 10” W.

56. 2182 Khz is a regulatory frequency for transmitting a distress signal.

57. 4125 Khz is monitored by COMSTA Kodiak.

58. The ALASKAN ROSE did not receive nor hear a distress call from the ARCTIC ROSE.

59. The INMARSAT-C system aboard the ALASKAN ROSE was overloaded with messages.

60. The ALASKAN ROSE was notified at approximately 0730, April 2, 2001 by C-130 of the ARCTIC ROSE EPIRB signal.

61. The ALASKAN ROSE assisted in the search and rescue case.

62. The ALASKAN ROSE received messages from Russia over their INMARSAT-C system.

63. The ALASKAN ROSE received the SafetyNET Alert but did not open/read the message.

64. The ALASKAN ROSE recovered the EPIRB.

65. The ALASKAN ROSE destroyed and sank the liferaft at the direction of the CG on-scene commander.

66. The ARCTIC ROSE received a CFVSE decal on September 9, 1999 in Unalaska, Alaska.

67. The ARCTIC ROSE was boarded at sea by a team from the USCGC STORIS on March 25, 2001 with no discrepancies noted.

68. NMFS requires certain fishing vessels to carry observers.

69. The ARCTIC ROSE as a H & G was considered a 30% boat requiring NMFS observer coverage 30% time of its fishing time.

70. All NMFS observers are required to receive adequate training, including safety training.

71. NMFS observers are provided by NMFS-approved third party contractors.

72. Fishing vessel owners arrange for NMFS observer coverage.

73. NMFS observers complete an out-brief upon completion of a deployment.

74. NMFS observers reported some safety concerns regarding occupational safety issues in the processing space and egress from the space in the event of an accident aboard the ARCTIC ROSE. One observer noted excessive water in the processing space. This information was not passed to the Coast Guard as it was deemed proprietary in nature by NMFS.

75. NWS weather forecasts are general in nature and cover a large area due to the lack of data collection buoys.

76. The HF Propagation report shows that a Mayday/distress call would have been heard on 4125 Khz.

77. Arctic Sole Seafoods Inc. did have drug testing policy requiring pre-employment testing of all employees.

78. Arctic Sole Seafoods did not follow their company drug testing policy.

79. The vessel had a history of difficulty in retaining qualified crew (deck and processing).

80. Three of the crew members were foreign nationals from Mexico working under assumed identities.

81. Both weathertight doors aboard the ARCTIC ROSE were located in alignment on the starboard side of the vessel.

82. There is no standard formatting for fishing vessel stability information as it is presented to mariners.

83. 46 CFR 28.255 required the vessel to have a water/processing space pump interlock.

84. Testimony revealed the ARCTIC ROSE engaged in processing as defined by 46 CFR 28.50, thus making it subject to additional stability criteria found in 46 CFR Part 28, Subpart E

ANALYSIS

VESSEL STABILITY

The Marine Board requested technical assistance from the Coast Guard's Marine Safety Center to conduct an independent stability analysis to determine the most likely cause of the loss of the ARCTIC ROSE. The Coast Guard's Marine Safety Center evaluated 19 different scenarios that could have lead to the loss of the ARCTIC ROSE. A flowchart of these scenarios is included as part of appendix 3. Furthermore, the appendix contains the results of each scenario's analysis. Each scenario pathway is colored to aid the reader. MSC used the best estimate of the loading condition of the vessel at the time of the casualty as the baseline for all stability calculations. The scenarios are arranged in order of decreasing probability, e.g. from the most likely scenario to the least likely scenario.

The stability calculations were performed using Creative Systems' General Hydrostatics (GHS) Version 7.50 software. These calculations were included as part of the analysis report provided by MSC to the Marine Board, but were not included in this report. This information is included as part of the information package submitted in support of this report and may be obtained by contacting the Marine Safety Center at 400 7th Street SW, Room 6308, Washington, DC 20590-0001.

Based on the loading conditions as recreated through analysis of the data gathered during the investigation, the ARCTIC ROSE at the time of the casualty would meet the righting arm characteristic criteria and severe wind and roll criteria listed in NVIC 5-86, if the processing space was maintained completely weathertight as required by the JMC stability letter dated July 9, 1999.

Dr. Bruce Johnson, Chair of the Society of Naval Architects and Marine Engineers Ad Hoc Panel on Fishing Vessel Operations and Safety, worked in concert with Lieutenant George Borlase of MSC to develop a progressive flooding analysis spreadsheet. This forensic analysis tool is based on quasi-static time steps through various progressive flooding scenarios into as many as six interior compartments where large free surface effects would negatively affect the vessel's stability.

The loss of the ARCTIC ROSE was most likely caused by progressive flooding from the aft deck into the processing space through the door in the aft bulkhead of the processing space. The vessel then probably flooded, rather rapidly, forward through the open door in the forward bulkhead of the processing space. The water then flooded into the galley and engine room through non-watertight doors, as analyzed in Scenario 1. Initial flooding of the lazarette/dry stores space or progressive flooding into the machinery space was not necessary for the vessel to lose all positive righting arm. The vessel would very likely lose all positive stability between 1 minute 40 seconds and 2 minutes 40 seconds, and sink in as little as 4 minutes and 6 seconds after progressive flooding started.

The arrangement of the ARCTIC ROSE increased the likelihood of progressive flooding from the processing space. The door from the processing space to the aft deck was far outboard on the

starboard side, reducing the heel angle at which water could enter the processing space. Additionally, the doors leading forward into the galley and also into the engine room were also on the starboard side of the vessel. A lolling angle to starboard caused by the inflow of water through the aft door and the free surface effect inside the processing space would cause water to easily spill forward into the galley and down into the engine room and eventually into the fish hold. The fish hold had a centerline hatch and would not flood significantly until sufficient water was in the processing space to spill into the fish hold. Additionally, it is very likely that none of the doors or hatches at the main deck were properly closed, which would increase the likelihood of progressive flooding throughout the ship.

The analysis established the three most likely causes of the progressive flooding into the processing space. The processing space could have flooded internally, from a wash-up hose left on or from the water supply to the plate freezers. The processing space could be flooded from the aft deck through the open aft door by boarding seas. Lastly, the space could have flooded through the open aft door if the vessel took a roll to starboard of only 23°. Regardless of how the water entered the processing space, the subsequent stability would most likely be very reduced, and progressive flooding would continue until the vessel sank. Had the processing space been maintained as weathertight as per the JMC stability booklet, the ARCTIC ROSE would not have sunk.

The time from when the ARCTIC ROSE lost all positive righting arm until all reserve buoyancy was lost and the vessel sank cannot be determined, nor can the Coast Guard determine if the vessel was inverted or upright when it sank. This is because the Coast Guard was unable to evaluate the ARCTIC ROSE's behavior while still on the surface of the water once the righting arm was no longer positive, nor were we able to evaluate how the vessel physically sank through the 428 foot water column until the vessel landed upright on the sea floor.

ARCTIC ROSE POSITION AND HEADING

The Marine Board conducted an analysis of the ARCTIC ROSE's position based on testimony provided by Mr. John Nelson, the EPIRB position and Captain Rundall's stated intent to remain in the area to begin fishing on the morning of April 2nd. Trawling vessels will give each other a wide berth to prevent their tow wires or nets from becoming entangled. The ARCTIC ROSE was maintaining a position to the northwest of the ALASKAN ROSE. At the time of the last sighting, the ARCTIC ROSE was moving away from the ALASKAN ROSE. The ALASKAN ROSE was running on a track line from Northeast to Southwest to maintain their position to fish at first light.

The Marine Board established a vessel heading of 315° T with a relative position of twelve miles northwest of the ALASKAN ROSE and making a turn to port at the approximate time of the casualty.

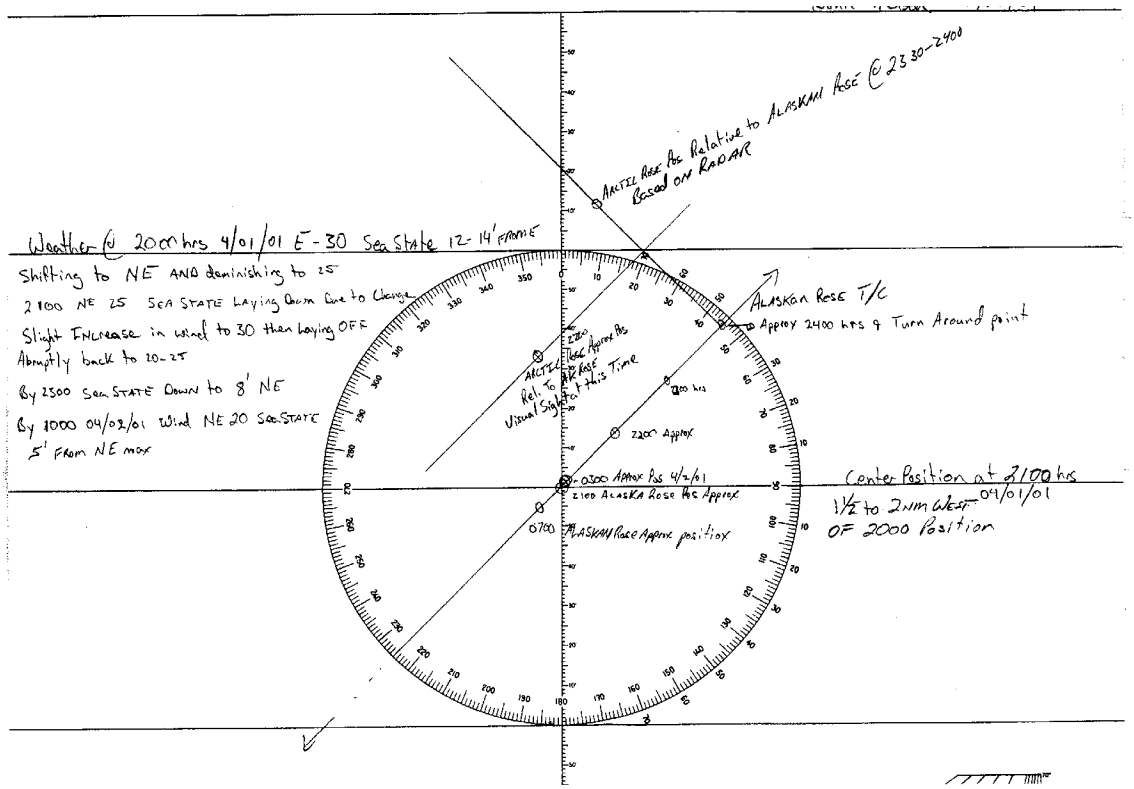


Figure 31
Universal plotting sheet depicting relative position and heading of ARCTIC ROSE on April 1 and 2

HEAD AND GUT OPERATION VERSUS PROCESSOR

The ARCTIC ROSE did engage in fish processing and as such was subject to the regulations applicable to a fish processor. The following chart depicts the difference between the ARCTIC ROSE, a H & G vessel and the ARCTIC ROSE, a fish processor.

H & G Operations	Fish Processor
Subpart B – all regulations apply	Subpart B – all regulations apply
Subpart C – applies only if operating beyond the boundary line or with more than sixteen persons on board	Subpart C – applies only if operating beyond the boundary line or with more than sixteen persons on board
Subpart E – only Part 28.501 applied to the ARCTIC ROSE	Subpart E – all regulations apply
Only examination of the vessel would have been the voluntary dockside exam and issuance of CFVSE decal	Subpart F – Surveyed once every two years by a class society or similarly qualified organization and issued a Certificate of Compliance
No load line required regardless of size.	Required to have a load line issued by a recognized third party.

The key difference between the two operations is that a fish processor must undergo a third party survey and have a load line issued by a class society. The load line is a critical element of safety in regards to a processing vessel. Load lines are assigned by Class Societies on behalf of the Coast Guard. All vessels must be routinely surveyed for watertight integrity and hull condition to maintain a load line assignment.

The JMC stability letter and booklet requires a minimum of six inches of freeboard to be maintained aboard the ARCTIC ROSE. It is unknown if this figure would have changed with the assignment of a load line.

CONCLUSIONS

1. The exact cause of this casualty is not known. However, casualties are very seldom caused by a single catastrophic event but rather are a series of events. It is the Marine Board's belief, based on a review of the weather hindcast, the vessel's last known position, and the most probable location of the vessel's desired first planned trawl on the morning of April 2, 2001, that the ARCTIC ROSE was in the process of turning or was jogging downwind with following seas when the vessel capsized to starboard. The remote video evidence of the open aft weathertight door to the processing space, the partially open starboard overboard discharge chute in the processing space, and the rudder hardover to port and mud gear over the starboard side were crucial to this determination. Because the aft weathertight door and starboard overboard discharge were open, contrary to the requirements of the vessel's stability letter, the processing space was not maintained in a weathertight condition. The rudder position is indicative of a human's natural reaction to correct for a starboard list. However, initially this action would likely prolong or increase the starboard list and allow sea water to initially enter the vessel through the open aft weathertight door. The ARCTIC ROSE sank due to an influx of water through the aft processing space weathertight door into the vessel. The weight of the water heeled the vessel to starboard allowing water to flow forward through the two weathertight doors located in the processing space. These two weathertight doors are located to starboard at the forward and aft bulkheads and are in alignment, further facilitating the ingress of seawater. Water then flooded into the machinery space through the trunk access just inside the mudroom. The vessel remained heeled over to starboard until rapid progressive flooding sank the vessel. The recovery of seven immersion suits found removed from their storage bags indicates someone was able to pull the suits from the bags. It is probable that a starboard list would facilitate a crewmember's access to the wooden immersion suit storage box, which was located on the port side aft of the pilothouse. Had the vessel rolled to port, it is unlikely that the immersion suits could have been removed from the box, let alone their storage bags. The extensive stability analysis conducted by the Marine Safety Center and the chair of the SNAME ad hoc fishing vessel panel further supports the Marine Board's theories.

2. The following scenarios are derived from a detailed review of all the evidence collected, testimony provided before the Marine Board during the hearings, and the stability analysis results. These scenarios are based on the most likely events that occurred, which led to the sinking of the ARCTIC ROSE.

    i. The vessel shipped water with quartering seas and the aft starboard door open to the processing space. The vessel rode best into the seas. The hull form was conducive to funneling the water on deck forward. Furthermore, the after deck arrangement with the dump box would limit the amount of surface area for the water to spread out. This would force the water depth to build up on the port and starboard sides. Any water entering the processing space would run forward due to the hull configuration. The Marine Board also heard testimony attesting to the fact that the crew kept the vessel trimmed forward; this condition would allow the water to flow forward. Given the vessel's loaded condition as calculated from the information provided by the owner, the vessel was trimmed forward making the angle of submersion for the bulwark 7°. The vessel needed to take a

23° roll to starboard with two weathertight doors open (aft processing space bulkhead and forward of processing space to mudroom) to arrive at the critical stage and begin to take on water.

ii. The vessel shipped water while turning to port to alter course and the aft weathertight door was open. The time of the sinking was about the time the vessel would turn downwind to get to the desired position (area where they caught a "clean bag" of fish) for their first trawl in the morning. A wave, most likely a secondary wave, lifted up the vessel's stern and dug the starboard side and bow into the water. The mate put the rudder to port to counter the list. The ARCTIC ROSE capsized[1] to starboard and then filled with water through the open weathertight doors located forward and aft on the starboard side of the processing space. It continued to downflood as water ingressed, sinking by the stern. Given the vessel's loaded condition as calculated from the information provided by the owner, the vessel was trimmed forward making the angle of submersion for the bulwark 7°. Since the vessel was kept trimmed forward, it would allow the water to flow forward in the vessel.

iii. The processing water was left on and unattended with the weathertight door open or shut. The vessel had an inexperienced crew with poor housekeeping skills. Testimony provided to the Marine Board stated that on two occasions the processing water was left running with the processing space unattended. This event flooded the factory deck with several inches of water. The vessel was kept trimmed forward. This condition would allow the water to flow forward in the vessel. Given the vessel's loaded condition as calculated from the information provided by the owner, the vessel was trimmed forward making the angle of submersion for the bulwark 7°. The Marine Board also heard testimony detailing a VHF discussion between the ALASKAN ROSE Mate and Captain Rundall indicating his disgust with the sump pumps getting plugged with trash the previous day.

The most probable scenario is a combination of scenarios i and ii.

4. The ARCTIC ROSE rolled to starboard.

5. The Coast Guard responded in a timely and appropriate manner for this case.

6. Given the condition of the captain's dress in the immersion suit and the amount of water in the suit at the time of recovery, there is a strong likelihood that he either donned the suit in the water or had it partially donned when the vessel sank.

7. Seven immersion suits in addition to the one Captain Rundall was wearing were recovered out of their storage bags indicating they were physically removed by someone just prior to the vessel sinking in the hope that the crew would escape and access the immersion suits.

8. The Marine Board was not able to discern if the liferaft was manually or hydrostatically released due to its destruction on-scene.

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[1] The term capsize is defined as any condition when a vessel will not return upright unless acted on by outside forces.

9. The Marine Board identified a software error in the COMSAT system, which reduced the priority of the Safety Alert to a Navigation Warning without the sender's consent or knowledge. The problem resided within the message routing software package for SafetyNET. This item was resolved in November 2001 with TELENOR updating its software by eliminating the default and allowing the sender to set the message parameter.

10. The use of a fisheries model INMARSAT-C aboard ALASKAN ROSE, which was not a GMDSS or SOLAS compliant system, affected the alarm and visibility status of any message or alert received. The system operator was handicapped by not having an external printing device nor an alarm for signaling receipt of Safety priority messages. This resulted in the delayed reading of the messages until well after they had been sent by the Coast Guard.

11. The INMARSAT-C system aboard the ALASKAN ROSE was not properly set to receive messages from one zone, thus it was overtaxed with messages from Russia.

12. The operators of the ALASKAN ROSE and ARCTIC ROSE were not properly trained to operate the INMARSAT-C system.

13. The ARCTIC ROSE was not fishing at the time of the incident.

14. The ARCTIC ROSE encountered a weather frontal system at the approximate time of the incident in the form of a triple point, which generated winds gusting in excess of 45 knots and significant wave heights to 24 ft.

15. There is no evidence that the use of drugs or alcohol by the vessel's Captain was a factor in this casualty. The Marine Board is unable to arrive at a determination concerning the remaining crewmembers as Arctic Sole Seafoods did not have a viable chemical testing program.

16. The crew's and fish processing personnel's limited experience in the fishing industry and aboard the ARCTIC ROSE is a causal factor to this casualty. The crew failed to maintain watertight integrity and on at least two occasions left water running which flooded the processing space. Poor housekeeping skills led to the clogging of the processing space dewatering pumps, which resulted in flooding the processing space.

17. There is evidence that the ARCTIC ROSE operated as a fish processing vessel and was not in compliance with the provisions of 46 CFR Part 28, Subpart F. This would have required the vessel to have a load line issued by a classification society and have a survey or third party issued Certificate of Compliance. An H & G vessel is not permitted to engage in fish processing activities.

18. The Coast Guard's voluntary dockside Commercial Fishing Vessel Safety Examination Program currently does not provide for a detailed assessment of the vessel's structure, hull integrity, critical systems or crew competence.

19. The Coast Guard and NMFS have a mutual interest in commercial fishing vessel safety.

20. The format of the stability letter issued to the ARCTIC ROSE, which is considered to be an industry standard, was complex in its presentation of critical information to the mariner and in a format difficult to understand and apply to daily operations.

21. There is evidence that the ARCTIC ROSE was in violation of 46 CFR Part 28.255 (b) by not having a functional interlock on the processing water system.

22. The ARCTIC ROSE was not in compliance with its stability letter operating guidelines issued by JMC.

23. The owner failed to keep track of all weight changes aboard the ARCTIC ROSE.

24. The owner failed to request a stability analysis for the ARCTIC ROSE after the weight changes.

RECOMMENDATIONS

Regulatory Changes

1. The Coast Guard should seek a legislative change to remove the grandfathering provisions provided for in 46 CFR 28.500 and require all fishing vessels and fish processors (including Head and Gut operations) over 79 ft in length to meet the stability requirements in 46 CFR Subpart E, or remove the exemption for fishing vessels in 46 CFR Subchapter E and require load line assignment.

2. The Coast Guard should develop regulations requiring all watertight and weathertight doors, required to be closed by a vessel's stability booklet to be alarmed and equipped with a visual and audible system in the pilothouse to indicate the position of the door(s).

3. All vessels equipped with either a processing space or a space used in the sorting of fish in which water is used should be fitted with high water alarms. These alarms must sound in the processing/sorting space and in the pilothouse.

4. The Coast Guard should review and re-evaluate the regulatory definition of processing vessels as it applies to fishing vessels, making sure it includes Head and Gut operations.

5. The Coast Guard should develop a regulation requiring all fishing vessels to document required drills found in 46 CFR 28.270.

6. Coast Guard Headquarters should remind all field units (Marine Safety and Operational) of the civil penalty provisions found in 46 USC 4507 and their applicability to the regulations found in 46 CFR Part 28.

7. In reviewing the overall SafetyNET system, the Marine Board found that there are no requirements for INMARSAT-C use on fishing vessels. This reduces the effectiveness of an important link of the GMDSS system. The Marine Board recommends requiring fishing vessels operating beyond the boundary line to be GMDSS compliant. The Marine Board understands a "one size fits all" requirement may not be the right solution and recommends Commandant evaluate the possibility of a regulation that has a regional approach tied to vessel operations, number of persons on board, duration of voyage, and distance offshore. The FCC and Coast Guard should partner during the development of these regulations.

8. The FCC and Coast Guard should require each fishing vessel equipped with a GMDSS system to have a properly trained operator.

9. The Coast Guard should develop a long range automated information system that incorporates two way communications for vessels equipped with a GMDSS satellite communications system, thus providing the Coast Guard with information on the location and identity of vessels operating in U.S. waters. This system could facilitate rescue coordination by providing the location and identity of vessels and two way communications capability to direct resources to the scene of a vessel in distress.

General Policy

10. The Coast Guard should encourage the use of color graphic displays within a stability booklet that are easily understood by mariners such as the one under development by SNAME.

11. The Coast Guard should review NVIC 5-86 to modernize the policy to reflect the changes in technology. Furthermore, the document should incorporate the MSC technical note 04-95 titled Lightship Change Determination; Weight-Moment Calculation vs. Deadweight Survey vs. Full Stability Test, which addresses weight changes triggering a new stability test for the vessel.

12. The Coast Guard should promulgate guidance addressing fishing vessel construction standards that minimize the free flow of water through a vessel.

13. The Coast Guard should remove all provisions that allow the use of above main deck spaces in the development of a fishing vessel's stability characteristics.

14. The Coast Guard should review the *significant alteration* and *major modification* policy as it applies to fishing vessels and promulgate guidance for its consistent application.

15. MSO Anchorage's and D13's dockside boardings of fishing vessels prior to high-risk fisheries to verify lifesaving equipment and stability letter compliance should be considered a best practice for use Coast Guard wide.

16. The Coast Guard and the commercial fishing industry should develop a non-regulatory program to encourage fishing vessel owners to track weight changes aboard their vessels and alterations that may impact a vessel's stability.

17. The Coast Guard should promulgate a policy to ensure the collection and preservation of all available evidence discovered on the scene of a marine casualty.

18. The Coast Guard should consider establishing investigation management teams to fill the positions on a Marine Board.

Training

19. The Coast Guard and the commercial fishing industry should explore the development of a minimal safety indoctrination program for all first time crew to include processors prior to getting underway and provide a means to document the training.

20. The Coast Guard and SNAME should develop regional stability and damage control workshops with a focus on fishing vessels operating within their specific region. The workshops should be a regularly scheduled event to coincide with national events such as COMFISH Expo. The agenda for these events at a minimum should include: stability,

damage control, and training requirements. The lessons/demonstrations should employ casualty data to reinforce the lessons.

21. The Coast Guard, FCC, INMARSAT-C system manufacturers and other safety organizations should develop training for the proper use of fisheries models INMARSAT-C systems. This training should be scheduled as workshops and incorporated as an element of national events such as COMFISH Expo.

Coast Guard Policy

22. The Coast Guard and NMFS should develop a MOU to facilitate the exchange of safety information obtained from observers serving aboard fishing vessels.

23. The Coast Guard in D17 should develop a similar MOU (as mentioned above) with the Alaska Department of Fish and Game to facilitate the exchange of safety information obtained from observers serving aboard fishing vessels.

24. The D17 staff needs to expand its efforts to promote the "Ready For Sea" program to all U.S. Coast Guard cutters operating in its AOR.

25. The crew of the ALASKAN ROSE should receive a Public Service Award for their actions and efforts during the recovery phase of the SAR Case. In particular the heroism of the mate, Mr. John Nelson, in the recovery of Captain David Rundall, should be recognized.

26. A copy of this report should be provided to the National Transportation Safety Board.

27. A copy of this report should be provided to the International Maritime Organization.

28. A copy of this report should be provided to families of the next-of-kin, members of the Commercial Fishing Industry Vessel Safety Advisory Committee and Arctic Sole Seafoods, Inc., the owner of the ARCTIC ROSE.

29. This report should be given wide dissemination throughout the commercial fishing industry vessel community including major fisheries journals, the National Council on Fishing Vessel Safety and Insurance, the North Pacific Fishing Vessel Owners' Association, The Alaska Marine Safety Education Association, The Society of Naval Architects and Marine Engineers, The Goundfish Forum and other major fishing industry vessel associations in the Pacific Northwest.

30. Notice of this report should be provided to each Coast Guard District Fishing Vessel Safety Coordinator.

31. Recommend this investigation be closed.

R. J. MORRIS, Captain, USCG
Chairman

J. R. BINGAMAN, Commander, USCG
Member

J. B. ROBERTSON, Lieutenant Commander, USCG
Member and Recorder

Appendix 1

SUMMARY OF MARINE BOARD ACTIVITIES

MARINE BOARD SUMMARY OF ACTIONS

The Marine Board conducted a myriad of activities, which were not captured in the Report. The Marine Board felt it necessary to share these experiences with the public and other Marine Boards so others may learn from our experience.

1. Investigation

The investigation was jointly conducted by investigators from the Coast Guard and the National Transportation Safety Board in various locales in Alaska, Washington and western United States. The investigators interviewed over a hundred witnesses in preparation for the hearing and to gather facts concerning the ARCTIC ROSE and its operation. The Marine Board launched an expedition to locate the wreck of the ARCTIC ROSE in order to conduct an underwater survey of the vessel as they searched for more possible clues and answers into the mystery.

2. Hearings

The hearings for the Marine Board were a monumental tasking. They were held in two locations, Anchorage and Seattle, to accommodate witness travel and reduce costs. The Marine Board received testimony from fifty five witnesses addressing diverse topics as vessel stability, vessel operations, manning, industry practices, weather conditions, communications and the Coast Guard response to the accident.

3. ROV Expeditions

These operations are covered extensively in the report and appendix 4. The use of ROVs to locate and survey the wreck of the ARCTIC ROSE was a critical tool for the Board.

Lessons Learned by the Marine Board:

- Accurate data collection is critical in determining a search area for a lost vessel. The Marine Board used many pieces of datum collected during the SAR case to develop the search grids used to locate the ARCTIC ROSE. This vastly narrowed the size of the search pattern and reduced the search time on scene. The wreck was located on the third pass during the search.

- Over power any ROV considered for a wreck expedition. The ROV will encounter many hazards including floating line which is fatal if ingested into the propulsion systems. A larger ROV with guards can reduce this hazard.

- Employ an ROV with video fore and aft and still photography capability. The Marine Board was able to create still photos from the video taken but at some expense and with some sacrifice of the quality of those stills.

- Ensure a detailed operations plan and briefing is provided to the team prior to the ROV entering the water. All stakeholders (Marine Board members, ROV technicians and key support vessel crew) should be included to critique the plan watching for pitfalls.

4. Family Briefs

The Marine Board was keenly sensitive to surviving family members needs and concerns. The Marine Board held meetings with the family members and contacted all members who were not in attendance prior to any release of video. The Marine Board showed the video, pausing it to explain their findings. The Thirteenth District Public Affairs staff developed a website exclusively for the ARCTIC ROSE which allowed the families and public to remain abreast of the case as it developed. These outreach efforts provided great relief to the families, fostering strong ties and support for the Coast Guard.

5. Support Staff

The Marine Board could not have completed the myriad of tasks without the help of a great network of support staff. Personnel from many units in the Thirteenth and Seventeenth Coast Guard Districts, including the Auxiliary, provided outstanding administrative, investigative, and public affairs support.

Planning, both long and short term, paid dividends for the Marine Board. The Marine Board met informally to discuss findings from the preliminary investigation, identify witnesses to appear before the Marine Board, and to develop a hearing schedule.

The Marine Board employed a divide and conquer technique. During the formative stages of the Marine Board and its investigation, they quickly sized up the multitude of tasks and skills required to conduct a thorough investigation of the casualty. The Marine Board employed the talents and skills of many individuals from various Coast Guard units to aid the Board in gathering and interpreting the data to reach sound conclusions and make reasonable recommendations. It cannot be stressed strongly enough to ensure the proper personnel with the technical expertise are bought into the project early on to keep the Marine Board aware of issues as they arise. Additionally, these individuals kept the Marine Board from being overwhelmed by technical data.

A key part of the Marine Board was the legal counsel provided by Coast Guard legal staff from both the Thirteenth and Seventeenth District staffs. These lawyers became involved early on in the investigation by supplying guidance to the Marine Board to preserve evidence, aiding with FOIA requests, processing paperwork necessary for the successful pursuit of a limited use immunity agreement, and protecting the Marine Board from violating the Privacy Act when information was released.

Appendix 2
HF PROPAGATION REPORT

IPS On Line GRAFEX HF PREDICTIONS

Point to point HF predictions anywhere in the world (Short Path).

Day:	02
Month:	04
Year:	2001
Transmitter Name:	NOJ
Transmitter Latitude:	57.783
Transmitter Longitude:	208.400
Receiver Name:	406 EPIRB
Receiver Latitude:	0
Receiver Longitude:	0

T index: 120 SSN: 122.42 10CM FLUX: 168.38

Longitude (decimal) is entered as degrees east. Latitude (decimal) entered as -ve for south +ve for north. If latitude and longitude appear as zero after entering Terminal name, you need to look up co-ordinates in Terminal lists below.

About GRAFEX Prediction

Northern Hemisphere Terminal List (45k)

Southern Hemisphere Terminal List (70k)

T index Information

Below is real time T index information based on autoscaled data. Real time T will depart from monthly predicted T during distrubances. No autoscaled data available is indicated by 999.

REAL TIME T INDICES FOR NORTHERN HEMISPHERE
AUTO SCALED DATA IS USED TO PRODUCE THESE INDICES
06 06 02 16 UT
Northern hemisphere T index: 127

REAL TIME T INDICES FOR SOUTHERN HEMISPHERE
AUTO SCALED DATA IS USED TO PRODUCE THESE INDICES
Southern hemisphere T index: 107

REAL TIME T INDICES FOR AUSTRALIAN REGION
AUTO SCALED DATA IS USED TO PRODUCE THESE INDICES
06 06 02 16 UT
Northern Equatorial Australian Region T index: 119
Northern Australian Region T index: 98
Southern Australian Region T index: 116
Australian Region T index: 108

REAL TIME T INDEX FOR NEW ZEALAND REGION
AUTO SCALED DATA IS USED TO PRODUCE THESE INDICES
New Zealand Region T index: 114

REAL TIME T INDEX FOR ANTARCTIC REGION
AUTO SCALED DATA IS USED TO PRODUCE THESE INDICES
Antarctic Region T index: 134

IPS Predicted and Observed Monthly T indices

The smoothed monthly T indices are used for longer term HF predictions. For such predictions you need to look up the appropriate T index in the "Predicted and Observed Monthly T indices" table and enter this index along with date and terminal details in the above form, then run the prediction.

ASAPS PC based HF Prediction System

IPS On Line GRAFEX HF PREDICTIONS

IPS GRAFEX HF FREQUENCY PREDICTIONS ADDRESS NO. 1234

Circuit: NOJ 406 EPIRB Date: 2 April, 2001 T-index: 120

Bearings: 285 85 Distance: 1411 km

First Mode				|--------F r e q u e n c y (MHz)---------|	Second Mode			
1F 16-26 1E 4				1 5 10 15 20 25 30 35 40	2F 34-47 2E 12			
UT	OWF	EMUF	ALF	| . . .|. . . .|. . . .|. . . .|. . . .|. . . .|. . . .|. . . .|	OWF	EMUF	ALF	UT
00	11.3	14.6	8.3	ASSXXM BPPP...	7.4	9.2	4.8	00
01	10.9	14.2	8.1	ASSXMM PPPP....	7.5	8.9	4.7	01
02	10.6	13.4	7.7	ASSXMM PPP%....	7.8	8.3	4.5	02
03	10.9	12.3	7.2	SSSMMM PP%%%....	7.9	7.4	4.3	03
04	10.8	10.5	6.3	ASSMMMM %%%%%....	7.8	6.1	3.9	04
05	10.6	7.3	4.7	SMMMMMM %%%%....	7.4	.0	3.2	05
06	9.4	2.4	.0	XMMMMMMMM% %%%...	6.6	1.5	.0	06
07	8.1	2.4	.0	XMMMMMMF%% %...	5.7	1.5	.0	07
08	6.8	2.4	.0	XMMMMM%%%...	4.8	1.5	.0	08
09	5.7	2.4	.0	XMMMMM%%...	4.2	1.5	.0	09
10	5.1	2.4	.0	XMMMM%%...	4.0	1.5	.0	10
11	4.8	2.4	.0	XMMMM%%..	3.9	1.5	.0	11
12	4.8	2.4	.0	XMMMM%%..	4.0	1.5	.0	12
13	4.9	2.4	.0	XMMMM%%..	4.1	1.5	.0	13
14	5.2	2.4	.0	XMMMM%%..	4.2	1.5	.0	14
15	5.4	2.4	.0	XMMMM%%..	4.3	1.5	.0	15
16	5.9	2.4	.0	XMMMMM%%..	4.5	1.5	1.3	16
17	6.8	8.2	5.1	SSMPP%...	4.9	3.8	3.4	17
18	8.4	10.9	6.5	ASXMBPP ...	5.5	6.4	4.0	18
19	9.7	12.5	7.3	SXXMBP PE..	6.0	7.6	4.4	19
20	10.5	13.6	7.8	ASXXBB PPE..	6.3	8.4	4.6	20
21	11.0	14.3	8.1	ASXXMB PPEE.	6.6	8.9	4.8	21
22	11.3	14.6	8.3	ASXXXB BPEE..	6.9	9.2	4.8	22
23	11.4	14.8	8.3	ASSXXM BPPE...	7.2	9.4	4.8	23
UT	OWF	EMUF	ALF	| . . .|. . . .|. . . .|. . . .|. . . .|. . . .|. . . .|. . . .|	OWF	EMUF	ALF	UT

|. USABLE LESS THAN 50% OF DAYS
|% USABLE (50%-90%) OF DAYS |
|B BOTH E&F MODES 90% OF DAYS
|M MIXED FIRST AND SECOND F MODES|
|F FIRST F MODE ONLY
|E E LAYER PROPN
| P 90%E &50-90%F|
|S SECOND MODES ONLY
|A HIGH ABSORPTION
| X COMPLEX MODES|

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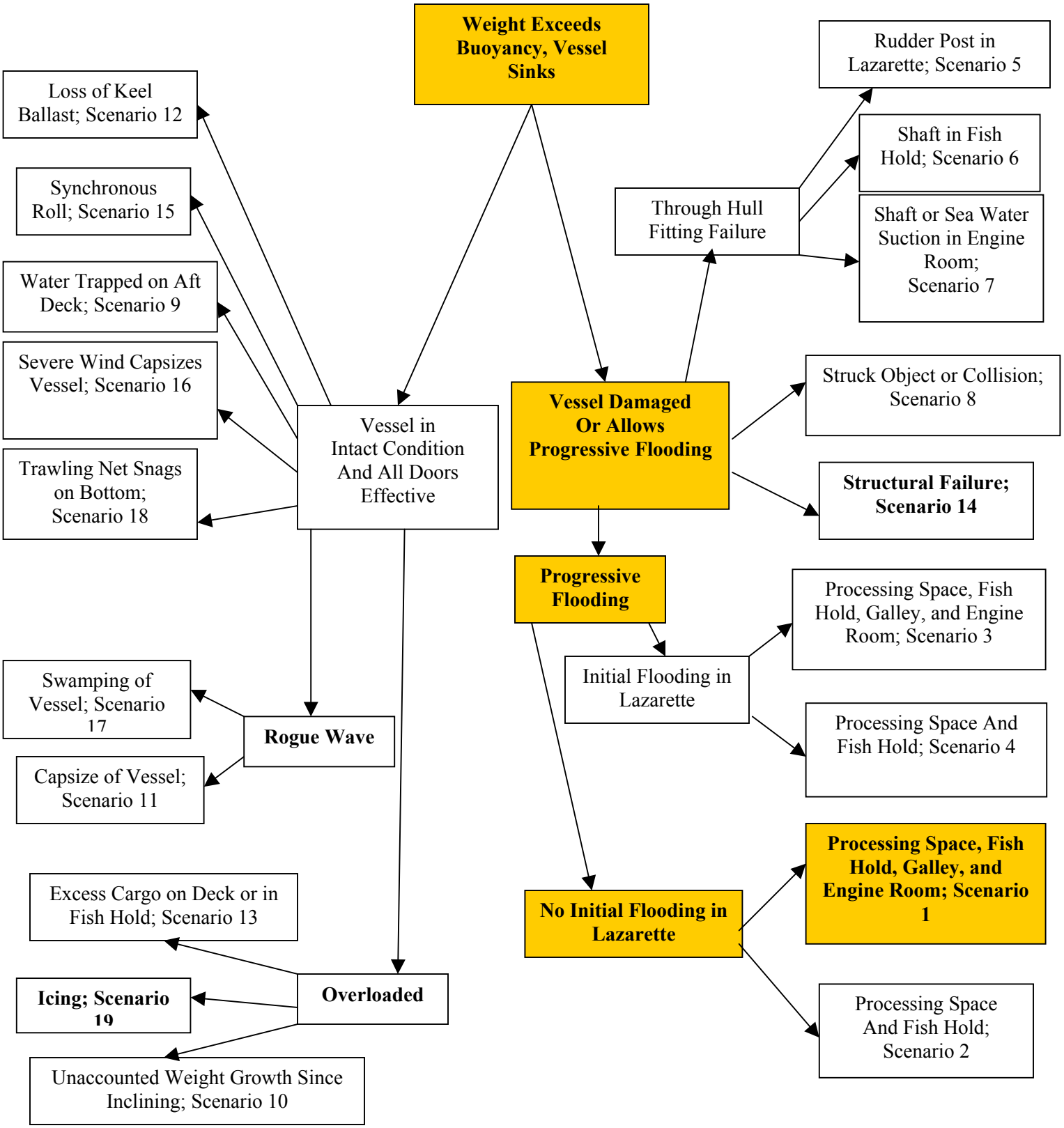
Appendix 3

STABILITY ANALYSIS[2]

[2] The enclosures and attachments mentioned in this appendix are part of the Marine Safety Center's analysis of the ARCTIC ROSE' stability. This information in not included as part of the report but is available from the Marine Safety Center in Washington, DC.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 1

PROGRESSIVE FLOODING INTO PROCESSING SPACE, FISH HOLD, GALLEY, AND ENGINE ROOM

Method of Analysis

1. The Coast Guard performed an analysis of the progressive flooding of the ARCTIC ROSE using the spreadsheet described in the analysis section of this report. The processing space, fish hold, galley, and engine room were allowed to progressively flood. Based on testimony provided to the Marine Board, the doors between the processing space and fish hold, processing space and galley, and galley and engine room were not watertight and often open or not closed using all the dogs, which could allow water to travel from one compartment to another. The lazarette was assumed to remain dry and watertight. Although the machinery space was not allowed to flood, the Coast Guard's analysis found that assuming the machinery space watertight did not significantly affect the results due to the small volume of the machinery space and the small free surface effect from water in the space.

2. Two different methods were used to calculate the roll angle of the ARCTIC ROSE for each time step. Progressive flooding analysis was preformed using the calculation of roll angle described in paragraph 8 of enclosure (4). The results of this analysis are included as attachment (1). A second analysis was performed by Dr. Bruce Johnson, assuming larger roll angles for the vessel, and including a period of very little wave action. The results of the second analysis are included as attachment (2).

Findings

3. Using the conservative roll angles in attachment (1), the ARCTIC ROSE would lose positive righting arm and no longer remain upright approximately two minutes forty seconds after progressive flooding began. Additionally, the vessel would lose all reserve buoyancy and sink beneath the surface less than eight minutes after progressive flooding began.

4. Using the larger roll angles in attachment (2), the ARCTIC ROSE would lose positive righting arm and no longer remain upright approximately one minute forty seconds after progressive flooding began. Additionally, the vessel would lose all reserve buoyancy and sink about four minutes six seconds after progressive flooding began.

5. The progressive flooding of the ARCTIC ROSE could have begun three different ways. The water inside the processing space could have originated inside the space, either from a hose left on or from water leaking from a plate freezer. The water could have entered the processing space from the aft deck. The pictures from the ROV show the aft starboard door open. Based on pictures, the starboard door leading from the processing space to the aft deck had a sill height of approximately one foot. Because the vessel was probably operating with forward trim at the time of the casualty, any water on

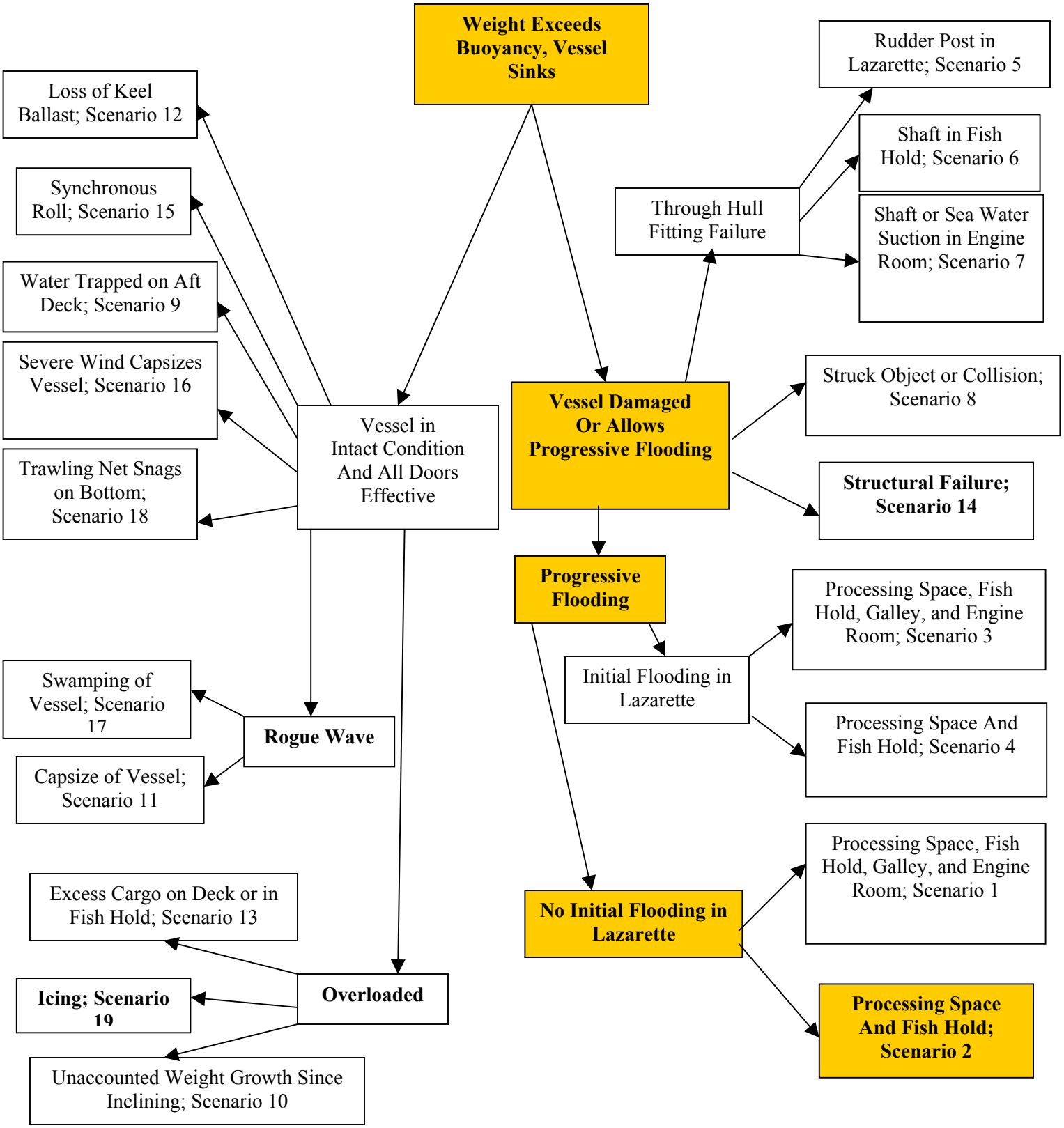
the aft deck would drain forward, and if there was more than one foot of water on deck, it likely could drain into the processing space. Lastly, water would directly enter the door from the sea if the vessel took a roll to starboard of only 23°. Based on our dynamic stability analysis, the ARCTIC ROSE would likely roll 23° if the vessel encountered a regular beam sea of less than twenty feet.

6. The ARCTIC ROSE reacted similarly to the progressive flooding of four spaces independent of the method for calculating the roll angle for the vessel. Once flooding water entered the processing space, the free surface effect from the wide processing space severely degraded the stability of the vessel. Due to the forward trim of the vessel, most of the flooding water would have drained from the processing space into the galley and engine room. The engine room probably very quickly filled with water. However, it was not the weight of the flooding water but the free surface effect that probably caused the vessel to lose all positive stability. Even at the last time step, the RA Corrected for KGF had a large range of positive stability and a maximum righting arm of 0.85 feet at 50 degrees. However, the free surface effect from flooding water in four spaces caused the righting arm to be negative at almost every angle of heel. The movement of water inside the spaces would have prevented the ARCTIC ROSE from remaining upright.

Conclusion

7. Based on the ARCTIC ROSE's rapid loss of positive stability and reserve buoyancy, the ROV video showing the aft door to the processing space open, testimony on the lack of watertight integrity above the main deck, and the arrangement of the vessel, it is most likely that progressive flooding of the processing space, fish hold, engine room, and galley was the cause of the loss of the ARCTIC ROSE.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 2

PROGRESSIVE FLOODING INTO PROCESSING SPACE AND FISH HOLD

Method of Analysis

1. The Coast Guard performed an analysis of the progressive flooding of the ARCTIC ROSE using the spreadsheet described in enclosure (4). The processing space and fish hold were allowed to progressively flood. Based on testimony provided to the Marine Board, the hatch between the processing space and fish hold was not watertight and often left or tied open or not secured with all the dogs, which could allow water to travel from the processing space to the fish hold. The lazarette was assumed to remain dry and watertight.

2. The progressive flooding analysis was performed using the calculation of roll angle described in paragraph 8 of enclosure (4). The results of this analysis are included as attachment (1).

Findings

3. Using the roll angles in attachment (1), the ARCTIC ROSE would lose positive righting arm and no longer remain upright approximately three minutes twenty seconds after progressive flooding began. Additionally, the vessel would lose all reserve buoyancy and sink beneath the surface about twenty-five minutes and thirty-five seconds after progressive flooding began.

4. The loss of reserve buoyancy in the processing space and fish hold of the ARCTIC ROSE would not alone cause the vessel to sink. The galley and engine room would also have to flood, and this additional loss of reserve buoyancy would result in the vessel sinking.

5. The progressive flooding of the ARCTIC ROSE could have begun three different ways. The water inside the processing space could have originated inside the space, either from a hose left on or from water leaking from a plate freezer. The water could have entered the processing space from the aft deck. The pictures from the ROV show the aft starboard door open. Based on pictures provided to the Marine Board, the starboard door leading from the processing space to the aft deck had a sill height of approximately one foot. Because the vessel was probably operating with forward trim at the time of the casualty, any water on the aft deck would drain forward, and if there was more than one foot of water on deck, it likely could drain into the processing space. Lastly, water would directly enter the door from the sea if the vessel took a roll to starboard of only 23°. Based on our dynamic stability analysis, the ARCTIC ROSE would likely roll 23° if the vessel encountered a regular beam sea of less than twenty feet.

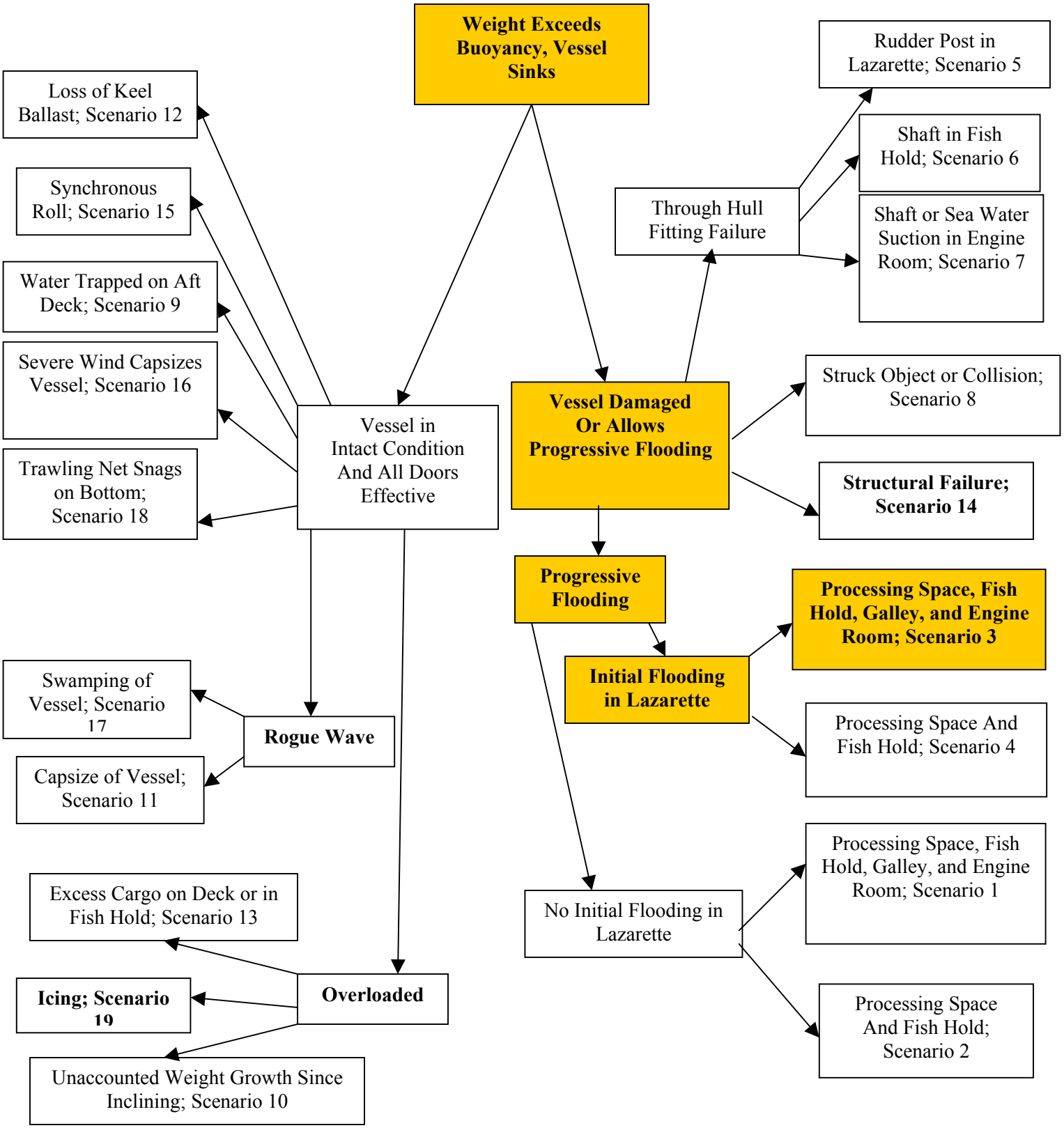
6. As in the progressive flooding scenarios described in enclosure (5), it was not the weight of the flooding water but the free surface effect that probably caused the vessel to

lose all positive stability. Even at the last time step, the RA Corrected for KGF had a large range of positive stability and a maximum righting arm of almost one foot at 50°. However, the free surface effect from flooding water in both spaces caused the righting arm to be negative at almost every angle of heel. The movement of water inside the spaces would have prevented the ARCTIC ROSE from remaining upright.

Conclusion

7. Based on the ARCTIC ROSE's rapid loss of positive stability and reserve buoyancy, the ROV video showing the aft door to the processing space open, testimony on the lack of watertight integrity above the main deck, and the arrangement of the vessel, it is likely that progressive flooding of the processing space and fish hold could have caused the loss of the ARCTIC ROSE. However, progressive flooding of the processing space and fish hold only is not the most likely scenario, because the non-weathertight doors leading into the changing room, engine room, and galley would have had to prevent any water entry. Testimony provided to the Marine Board indicated this weathertight door from the processing space to the mudroom was always open. The loss of reserve buoyancy of the processing space and fish hold alone would probably not be enough to sink the vessel.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 3

PROGRESSIVE FLOODING INTO PROCESSING SPACE, FISH HOLD, GALLEY, AND ENGINE ROOM WITH LAZARETTE FLOODED TO EQUILIBRIUM

Method of Analysis

1. The Coast Guard performed an analysis of the progressive flooding of the ARCTIC ROSE using the spreadsheet described in enclosure (4). The lazarette and dry hold of the vessel were modeled as one compartment due to the lack of a watertight bulkhead between the spaces, and identified that space as the lazarette throughout our analysis. The lazarette was flooded to equilibrium, then the processing space, fish hold, galley, and engine room were allowed to progressively flood. Based on testimony provided to the Marine Board, the doors between the processing space and fish hold, processing space and galley, and galley and engine room were not watertight and often left open, which could allow water to travel from one compartment to another. Although the machinery space was not allowed to flood, the Coast Guard's analysis found that assuming the machinery space watertight did not significantly affect the results due to the small volume of the machinery space and the small free surface effect from water in the space.

2. A progressive flooding analysis was performed of the ARCTIC ROSE using the calculation of roll angle described in paragraph 8 of enclosure (4). The results of this analysis are included as attachment (1).

Findings

3. Using the roll angles in attachment (1), the ARCTIC ROSE would lose positive righting arm and no longer remain upright approximately two and a half minutes after progressive flooding began. Additionally, the vessel would lose all reserve buoyancy and sink beneath the surface in five minutes and nineteen seconds after progressive flooding began.

4. The progressive flooding of the ARCTIC ROSE could have begun three different ways. The water inside the processing space could have originated inside the space, either from a hose left on or from water leaking from a plate freezer. The water could have entered the processing space from the aft deck. The pictures from the ROV show the aft starboard door open. Based on pictures provided to the Marine Board, the starboard door leading from the processing space to the aft deck had a sill height of approximately one foot. Because the vessel was probably operating with forward trim at the time of the casualty, any water on the aft deck would drain forward, and if there was more than one foot of water on deck, it likely could drain into the processing space. Lastly, water would directly enter the door from the sea if the vessel took a roll to starboard of only 23°. Based on the dynamic stability analysis, the ARCTIC ROSE would likely roll 23° if the vessel encountered a regular beam sea of less than twenty feet.

5. As in the progressive flooding scenarios described in enclosure (5), it was not the weight of the flooding water but the free surface effect that probably caused the vessel to lose all positive stability. Even at the last time step, the RA Corrected for KGF had a large range of positive stability and a maximum righting arm of almost 0.9 feet at 50°. However, the free surface effect from flooding water in both spaces caused the righting arm to be negative at almost every angle of heel. The movement of water inside the spaces would have prevented the ARCTIC ROSE from remaining upright.

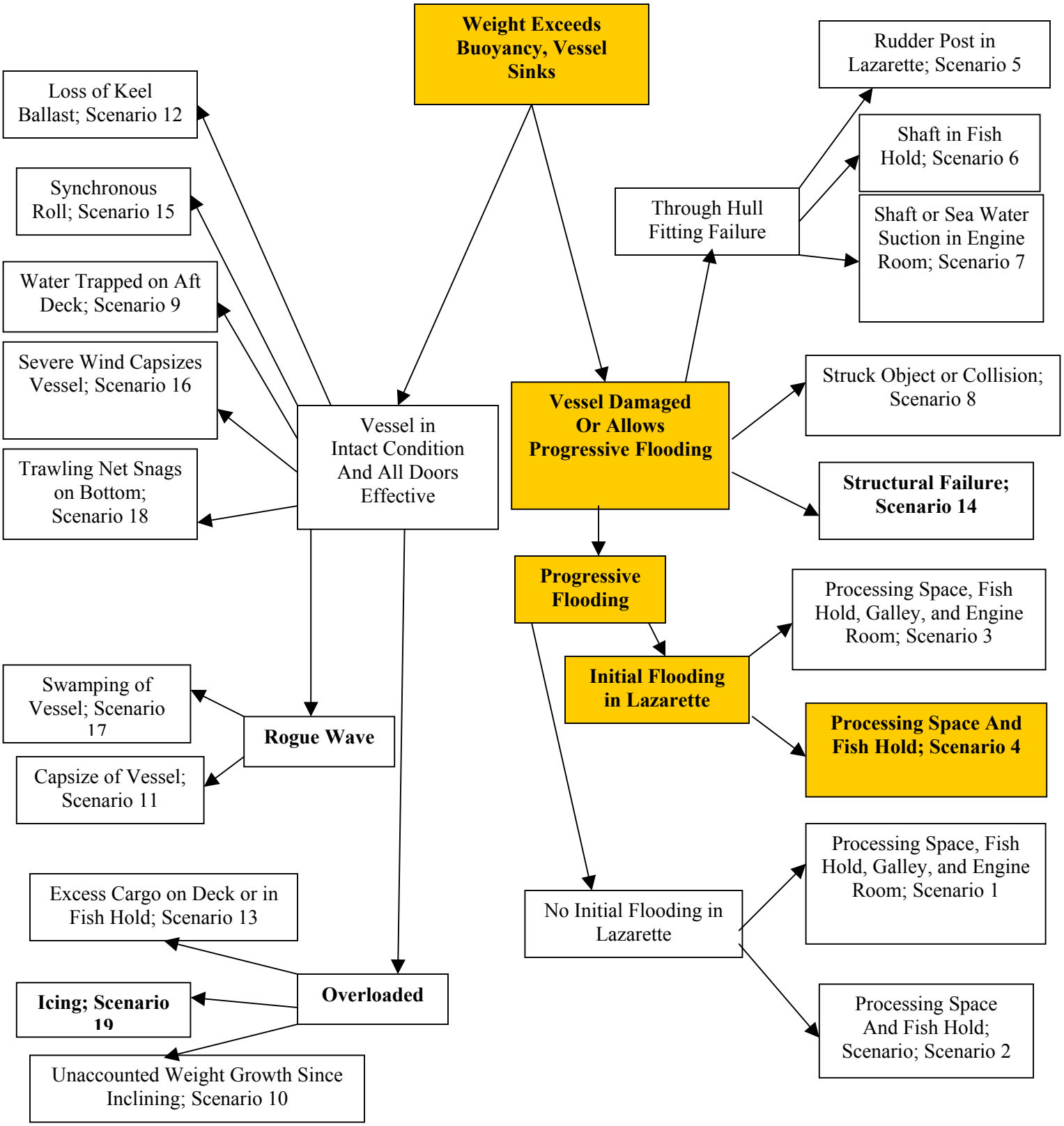
6. The flooding of the lazarette to equilibrium before progressively flooding the rest of the vessel most likely did not significantly change either the time to capsize or the time to sink from the progressive flooding analysis in enclosure (5). The weight low in the lazarette only slightly increased the righting arm by lowering the vertical center of gravity and did not cause an appreciable change in aft trim.

7. Testimony provided to the Marine Board indicated the lazarette and dry stores space was equipped with a high water bilge alarm that would sound on the bridge. However, there is no indication that the bilge alarm sounded for the lazarette or that there was water in the space at the time of the casualty.

Conclusion

8. Based on the ARCTIC ROSE's rapid loss of positive stability and reserve buoyancy, the ROV video showing the aft door to the processing space open, testimony on the lack of watertight integrity above the main deck, and the arrangement of the vessel, it is possible that progressive flooding of the processing space, fish hold, engine room, and galley after the lazarette flooded to equilibrium was the cause of the loss of the ARCTIC ROSE. However, based on the lack of evidence the lazarette was flooded at the time of the casualty, it is not the most likely scenario analyzed.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 4

PROGRESSIVE FLOODING INTO PROCESSING SPACE AND FISH HOLD WITH LAZARETTE FLOODED TO EQUILIBRIUM

Method of Analysis

1. The Coast Guard performed an analysis of the progressive flooding of the ARCTIC ROSE using the spreadsheet described in enclosure (4). The lazarette and dry hold of the vessel were modeled as one compartment due to the lack of a watertight bulkhead between the spaces, and identified that space as the lazarette throughout our analysis. The lazarette was flooded to equilibrium, then the processing space and fish hold were allowed to progressively flood. Based on testimony provided to the Marine Board, the hatch between the processing space and fish hold was not watertight, which could allow water to travel from the processing space to the fish hold. Although the machinery space was not allowed to flood, the Coast Guard's analysis found that assuming the machinery space watertight did not significantly affect the results due to the small volume of the machinery space and the small free surface effect from water in the space.

2. A progressive flooding analysis was performed of the ARCTIC ROSE using the calculation of roll angle described in paragraph 8 of enclosure (4). The results of this analysis are included as attachment (1).

Findings

3. Using the roll angles in attachment (1), the ARCTIC ROSE would lose positive righting arm and no longer remain upright approximately two minutes fifty-three seconds after progressive flooding began. Additionally, the vessel would lose all reserve buoyancy and sink beneath the surface about thirteen minutes and eleven seconds after progressive flooding began.

4. The loss of reserve buoyancy in the processing space and fish hold of the ARCTIC ROSE would not alone cause the vessel to sink. The galley and engine room would also have to flood, and this additional loss of reserve buoyancy would result in the vessel sinking.

5. The progressive flooding of the ARCTIC ROSE could have begun three different ways. The water inside the processing space could have originated inside the space, either from a hose left on or from water leaking from a plate freezer. The water could have entered the processing space from the aft deck. The pictures from the ROV show the aft starboard door open. Based on pictures provided to the Marine Board, the starboard door leading from the processing space to the aft deck had a sill height of approximately one foot. Because the vessel was probably operating with forward trim at the time of the casualty, any water on the aft deck would drain forward, and if there was more than one foot of water on deck, it likely could drain into the processing space. Lastly, water would directly enter the door from the sea if the vessel took a roll to

starboard of only 23°. Based on the Coast Guard's dynamic stability analysis, the ARCTIC ROSE would likely roll 23° if the vessel encountered a regular beam sea of less than twenty feet.

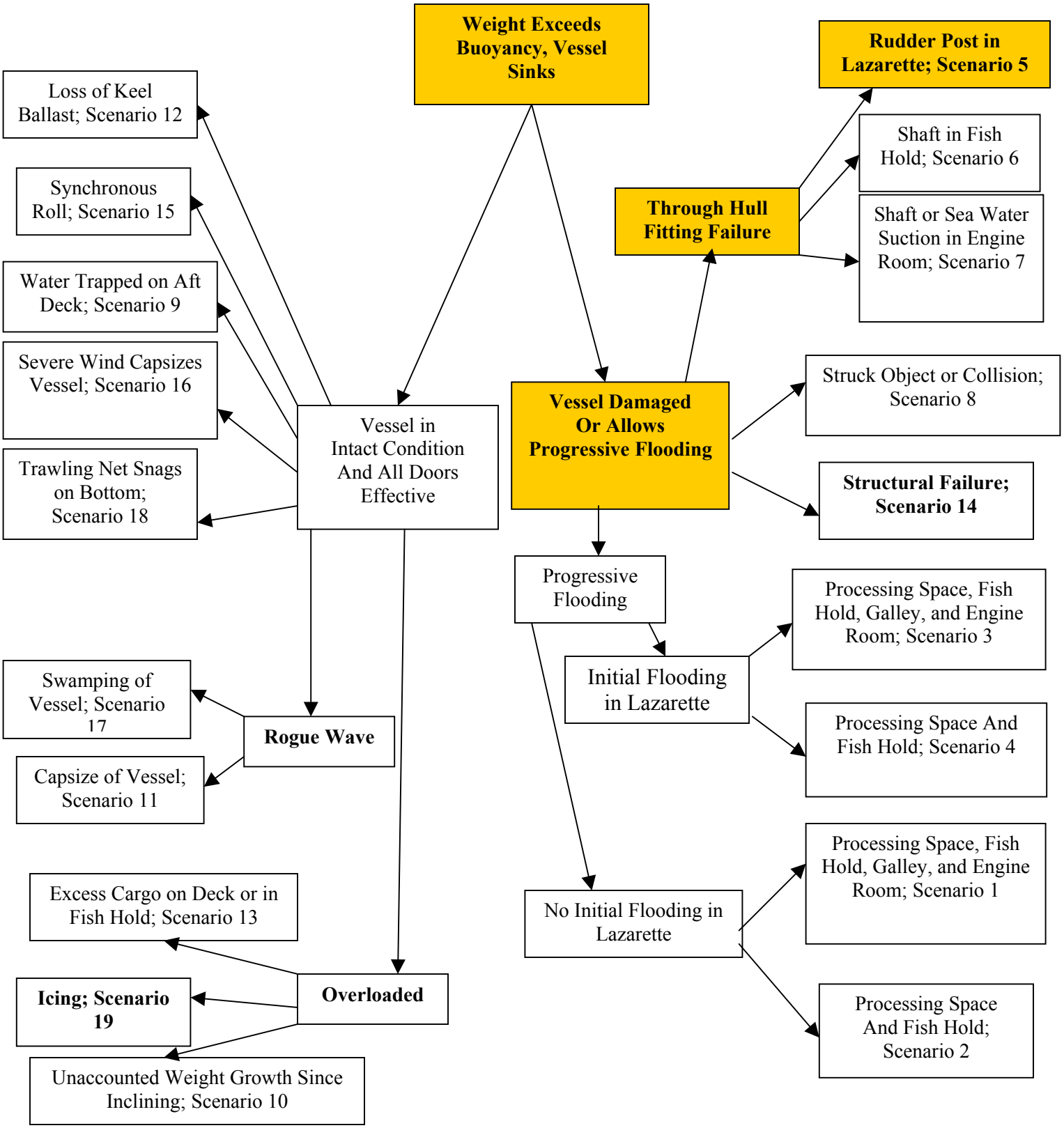
6. As in the progressive flooding scenarios described in enclosure (5), it was not the weight of the flooding water but the free surface effect that probably caused the vessel to lose all positive stability. Even at the last time step, the RA Corrected for KGF had a large range of positive stability and a maximum righting arm of about one foot at 50°. However, the free surface effect from flooding water in both spaces caused the righting arm to be negative at almost every angle of heel. The movement of water inside the spaces would have prevented the ARCTIC ROSE from remaining upright.

7. Testimony provided to the Marine Board indicated the lazarette and dry hold space was equipped with a high water bilge alarm that would sound an alarm on the bridge. However, there is no indication that the bilge alarm sounded for the lazarette or that there was water in the space at the time of the casualty.

Conclusion

8. Based on the ARCTIC ROSE's rapid loss of positive stability and reserve buoyancy, the ROV video showing the aft door to the processing space open, testimony on the lack of watertight integrity above the main deck, and the arrangement of the vessel, it is possible that progressive flooding of the processing space and fish hold after the lazarette flooded to equilibrium was the cause of the loss of the ARCTIC ROSE. However, based on the lack of evidence the lazarette was flooded at the time of the casualty, and the necessity for other spaces to eventually flood, it is not the most likely scenario analyzed.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 5

THROUGH HULL FITTING FAILURE: RUDDER POST IN LAZARETTE AND DRY HOLD

Method of Analysis

1. The Coast Guard performed a static stability analysis on the ARCTIC ROSE using GHS and the most likely assumed loading conditions at the time of the casualty to determine the vessel's ability to survive flooding at a through hull fitting. In order to simulate flooding through the rudder post, the lazarette and dry hold spaces in the computer model provided by Jensen Maritime Consultants were flooded, and the resulting vessel stability characteristics were calculated and compared to the intact righting arm criteria and damaged righting arm criteria in reference (b). Additionally, the ROV tapes were reviewed for signs of structural damage in the vicinity of the lazarette and dry hold.

Findings

2. The Coast Guard found that flooding the lazarette and dry stores spaces on the ARCTIC ROSE did not significantly change the righting arm characteristics of the vessel as shown in attachment (1). While the vessel did not meet all the intact stability requirements in the damaged condition, the range of stability was still over 90 degrees, and the magnitude of the maximum righting arm was over 1 foot. The vessel easily met the damaged stability criteria for fishing vessels, which the ARCTIC ROSE was not required to meet due to the age of the vessel. If the lazarette and dry stores spaces had flooded onboard the vessel, the vessel should have maintained its ability to remain upright.

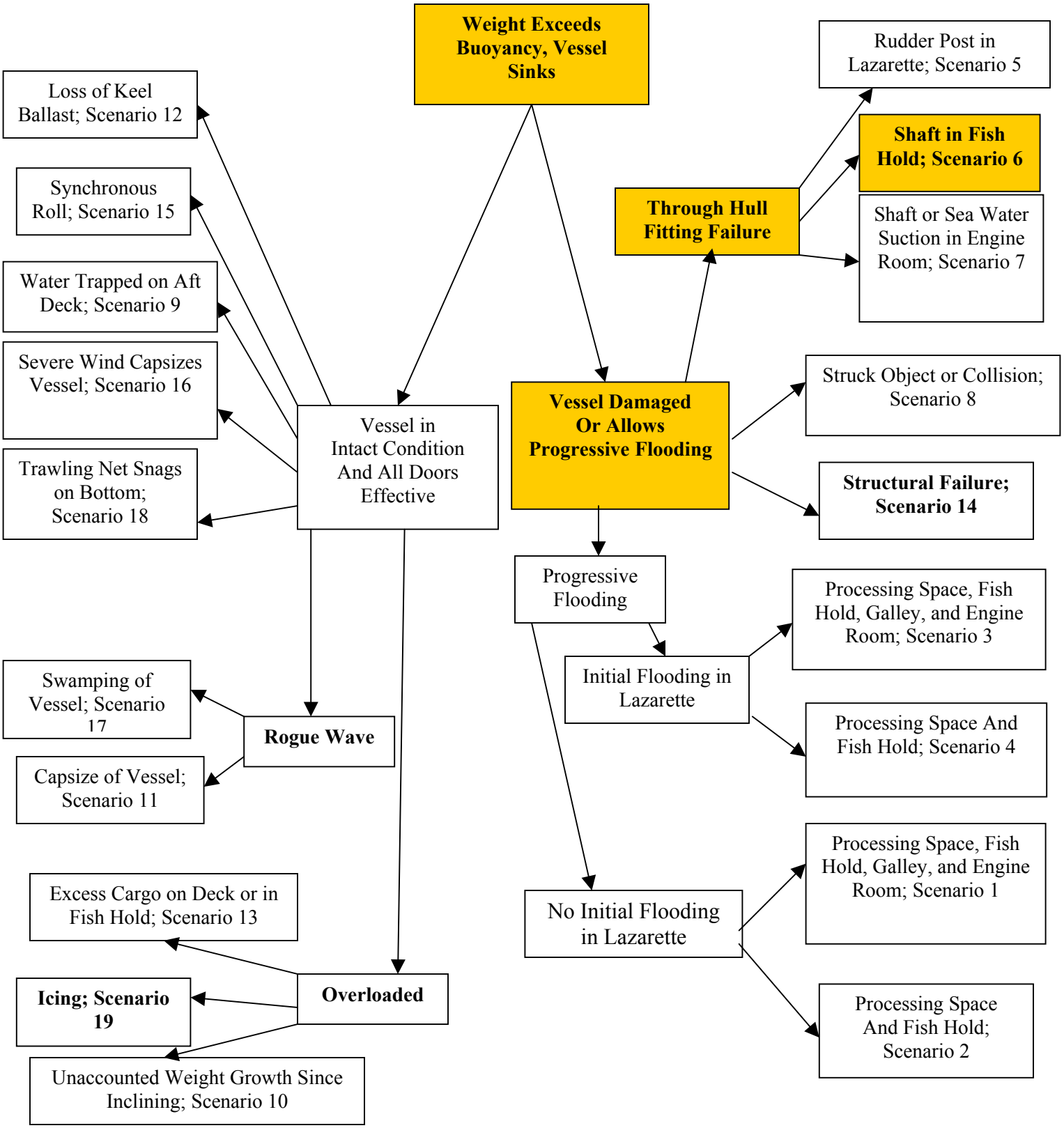
3. Review of the ROV tapes taken of the ARCTIC ROSE, did not provide a view of the deck over the lazarette and dry hold. There was no evidence of structural damage in the side shell or bottom plating. Though the rudder appears to be hard over to port, and there is a small crease in the bottom of the rudder, the condition of the rudder post and its connection to the hull is not known.

4. Testimony provided to the Marine Board indicated the lazarette and dry stores space was equipped with a high water bilge alarm that would sound an alarm on the bridge. However, there is no indication that the bilge alarm sounded for the lazarette and dry stores or that there was water in the space at the time of the casualty.

Conclusion

5. Based on the ARCTIC ROSE's stability characteristics with the lazarette and dry stores spaces flooded and the lack of evidence of structural damage around the rudder post, it is unlikely that the loss of the ARCTIC ROSE was due to failure of a through hull fitting in the lazarette and dry store spaces.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 6

THROUGH HULL FITTING FAILURE: SHAFT IN FISH HOLD

Method of Analysis

1. The Coast Guard performed a static stability analysis on the ARCTIC ROSE using GHS and the most likely assumed loading conditions at the time of the casualty to determine the vessel's ability to survive flooding at a through hull fitting. In order to simulate flooding through the shaft bearings, the fish hold in the computer model provided by Jensen Maritime Consultants was flooded, and the resulting vessel stability characteristics were calculated and compared to the intact righting arm criteria and damaged righting arm criteria in reference (b). Additionally, the ROV tapes were reviewed for signs of structural damage in the vicinity of the shaft exit from the hull and the fish hold.

Findings

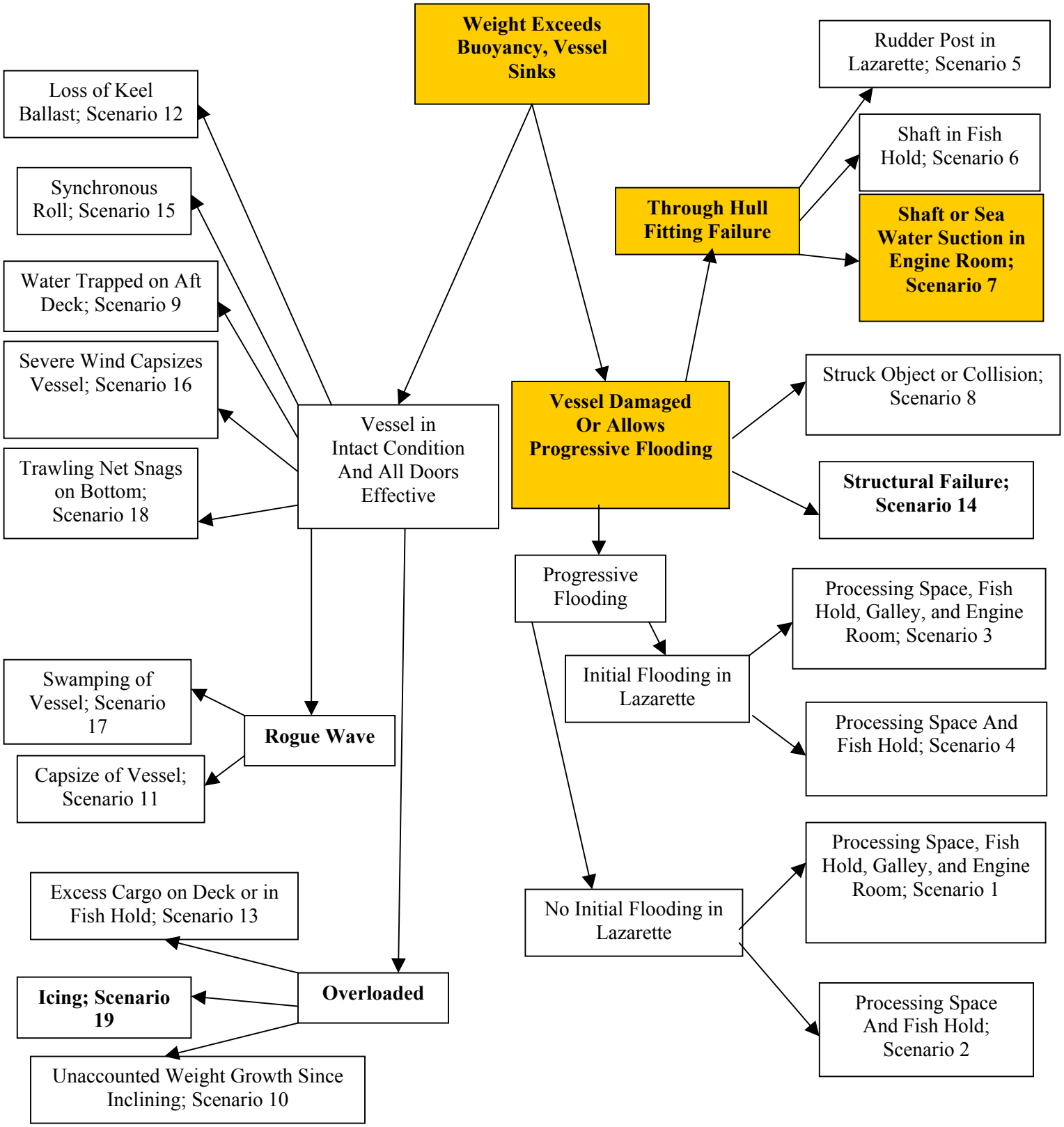
2. The Coast Guard found that flooding the fish hold space on the ARCTIC ROSE did not significantly change the righting arm characteristics of the vessel as shown in attachment (1). The vessel met both the intact and the damaged stability criteria for fishing vessels with the fish hold space flooded. The ARCTIC ROSE was not required to meet the damage stability criteria due to the age of the vessel. The additional weight of the flooding water in the fish hold would have increased the vessel's displacement by thiry percent, and reduced the freeboard so that the aft deck was underwater about three inches. If the fish hold had flooded onboard the ARCTIC ROSE from the failure of a through hull fitting, the vessel should have maintained its ability to remain upright.

3. Review of the ROV tapes taken of the ARCTIC ROSE did not provide a view of the shaft alley area of the fish hold. There was no evidence of structural damage in the side shell or bottom plating at the fish hold though.

Conclusion

4. Based on the ARCTIC ROSE's stability characteristics with the fish hold space flooded and the lack of evidence of structural damage at a through hull fitting, it is unlikely that the loss of the ARCTIC ROSE was due to failure of a through hull fitting in the fish hold.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 7

THROUGH HULL FITTING FAILURE: SHAFT OR SEA SUCTION IN ENGINE ROOM AND MACHINERY SPACE

Method of Analysis

1. The Coast Guard performed a static stability analysis on the ARCTIC ROSE using GHS and the most likely assumed loading conditions at the time of the casualty to determine the vessel's ability to survive flooding at a through hull fitting. In order to simulate flooding through one of the various fittings in the engine room, the engine room and machinery space in the computer model provided by Jensen Maritime Consultants was flooded, and the resulting vessel stability characteristics were calculated and compared to the intact righting arm criteria and damaged righting arm criteria in reference (b). Additionally, the ROV tapes were reviewed for signs of structural damage in the vicinity of the engine room and machinery space.

Findings

2. The Coast Guard found that flooding the engine room and machinery space on the ARCTIC ROSE did not significantly change the righting arm characteristics of the vessel, as shown in attachment (1). The vessel met both the intact and the damaged stability criteria for fishing vessels with the engine room and machinery space flooded. The ARCTIC ROSE was not required to meet the damage stability criteria due to the age of the vessel. The additional weight of the flooding water in the engine room and machinery space would have increased the vessel's displacement by thirty three percent, and reduced the freeboard so that the aft deck was underwater about two feet. If the engine room and machinery space had flooded onboard the ARCTIC ROSE from the failure of a through hull fitting, the vessel should have maintained its ability to remain upright.

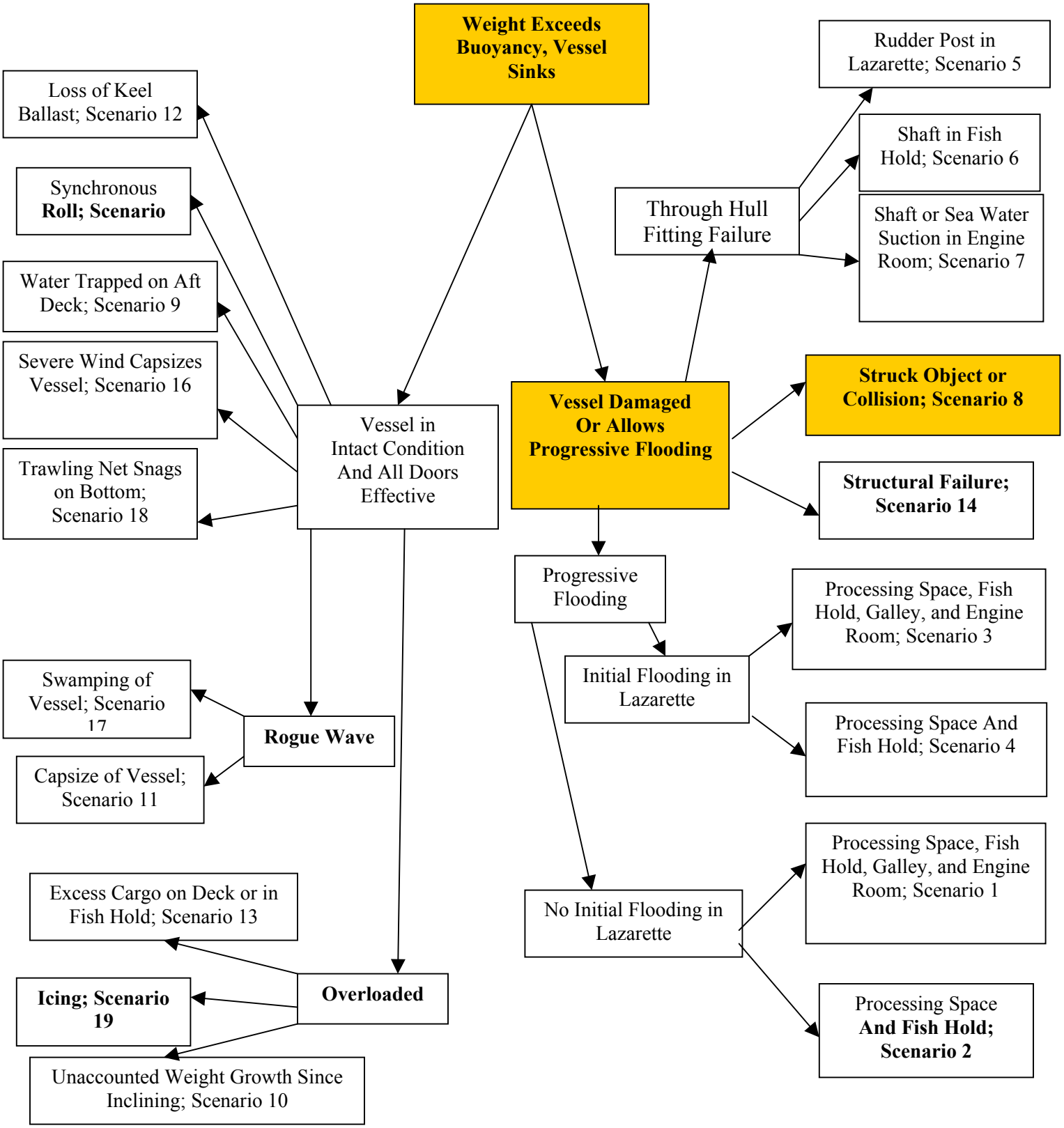
3. Review of the ROV tapes taken of the ARCTIC ROSE did not provide a view of the engine room and machinery space directly. There was no evidence of structural damage in the side shell or bottom plating from outside the hull though.

4. Testimony provided to the Marine Board indicated the engine room space was equipped with a high water bilge alarm that would sound an alarm on the bridge. However, there is no indication that the bilge alarm sounded for the engine room or that there was water in the space at the time of the casualty.

Conclusion

5. Based on the ARCTIC ROSE's stability characteristics with the engine room and machinery space flooded and the lack of evidence of structural damage around the engine room, it is unlikely that the loss of the ARCTIC ROSE was due to failure of a through hull fitting in the engine room or machinery space.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 8

STRUCK OBJECT OR COLLISION

Method of Analysis

1. The Coast Guard performed a static stability analysis on the ARCTIC ROSE using GHS and the most likely assumed loading conditions at the time of the casualty to determine the vessel's ability to survive flooding from striking an object or from a collision. The Coast Guard has evaluated the vessel's ability to survive flooding of the lazarette and dry hold, fish hold, and engine room and machinery space in enclosures (9) through (11), respectively. Therefore, fuel oil wing tanks #2 and #3 were flooded to simulate asymmetric damage to the vessel from a collision. Additionally, the forepeak compartment was flooded to simulate the ARCTIC ROSE colliding bow-on with an object.

2. In order to simulate flooding from striking an object or from a collision, the compartments in the computer model provided by Jensen Maritime Consultants were flooded, and the resulting vessel stability characteristics were calculated and compared to the intact righting arm criteria and damaged righting arm criteria in reference (b). Additionally, the ROV tapes were reviewed for signs of structural damage in the vicinity of the shaft exit from the hull and the fish hold.

Findings

3. The Coast Guard found that flooding the two fuel oil wing tanks to simulate asymmetric damage to the ARCTIC ROSE did not significantly change the righting arm characteristics of the vessel, as shown in attachment (1). The vessel met both the intact and the damaged stability criteria for fishing vessels with the fish hold space flooded, except for the minimum metacentric height requirement for intact stability. Additionally, the vessel would only heel over about 6 degrees due to the off-center flooded water weight. The ARCTIC ROSE was not required to meet the damage stability criteria due to the age of the vessel. If the fuel oil wing tanks had been damaged from striking a submerged object or from a collision, the vessel should have maintained its ability to remain upright.

4. The Coast Guard found that flooding the forepeak compartment on the ARCTIC ROSE did not significantly change the righting arm characteristics of the vessel, as shown in attachment (2). The vessel met both the intact and the damaged stability criteria for fishing vessels with the forepeak flooded. If the forepeak compartment had flooded onboard the ARCTIC ROSE from striking a submerged object or from a collision, the vessel should have maintained its ability to remain upright.

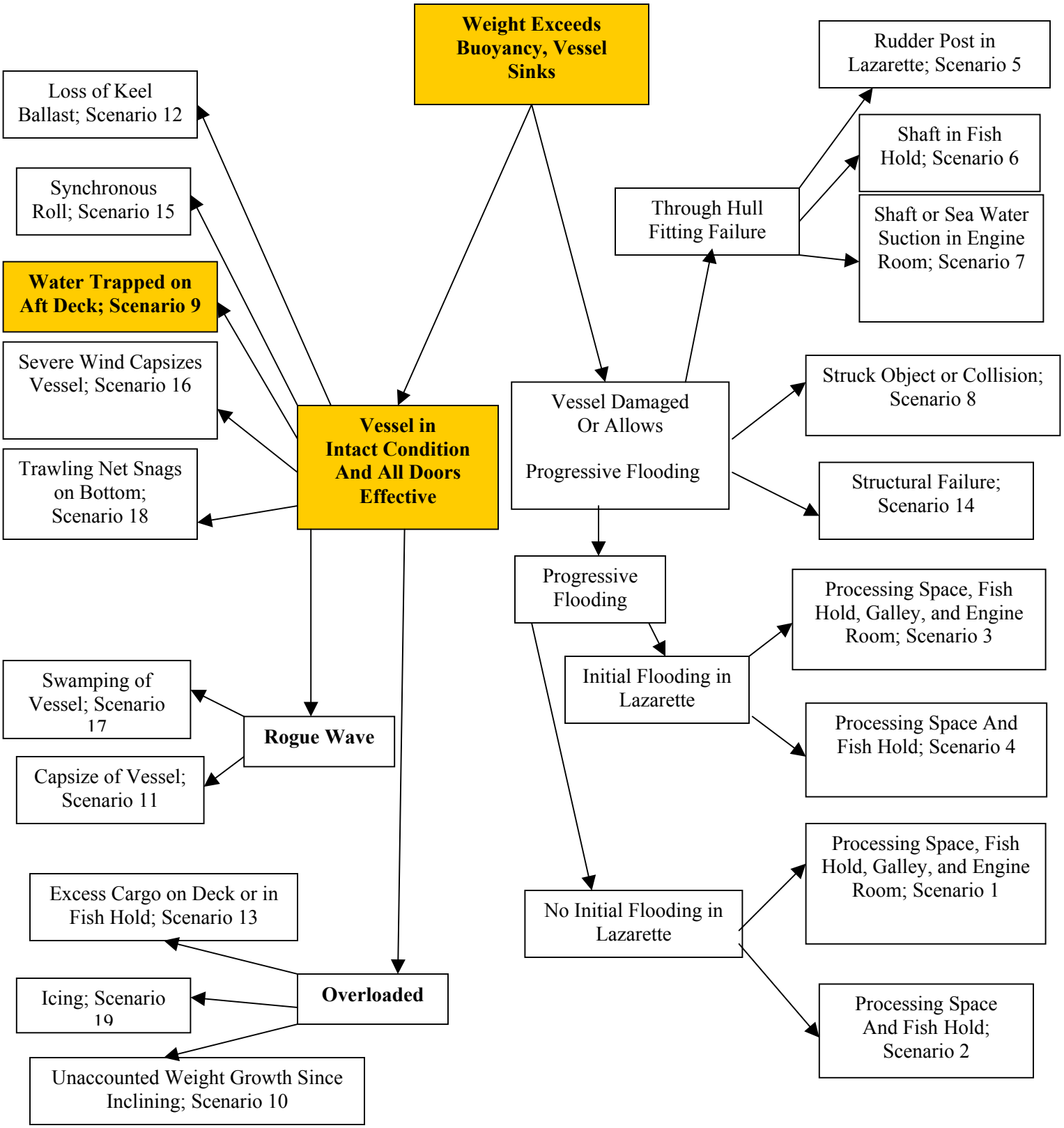
5. Review of the ROV tapes taken of the ARCTIC ROSE did not provide a view of the port bottom of the vessel. There was no evidence of structural damage in the side shell or

bottom plating to indicate the vessel had either struck a submerged object or had been involved in a collision.

Conclusion

6. Based on the ARCTIC ROSE's stability characteristics with either the fuel oil wing tanks or the forepeak compartment flooded, and the lack of evidence of structural damage on the outside of the vessel, it is unlikely that the loss of the ARCTIC ROSE was due to striking a submerged object or colliding with an object.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 9

WATER TRAPPED ON AFT DECK

Method of Analysis

1. The Coast Guard performed a static stability analysis to evaluate the stability of the ARCTIC ROSE with water trapped on the aft deck. The aft deck was modeled as an additional compartment using the computer model of the vessel provided by Jensen Maritime Consultants. The compartment was modeled without the dump truck in place, which resulted in a conservative free surface moment. The aft deck compartment was then filled with one foot of water, and the resulting righting arms calculated and compared to the stability criteria. The Coast Guard also reviewed the ROV tapes for blocked freeing ports or other signs that water could have been trapped on the aft deck.

Findings

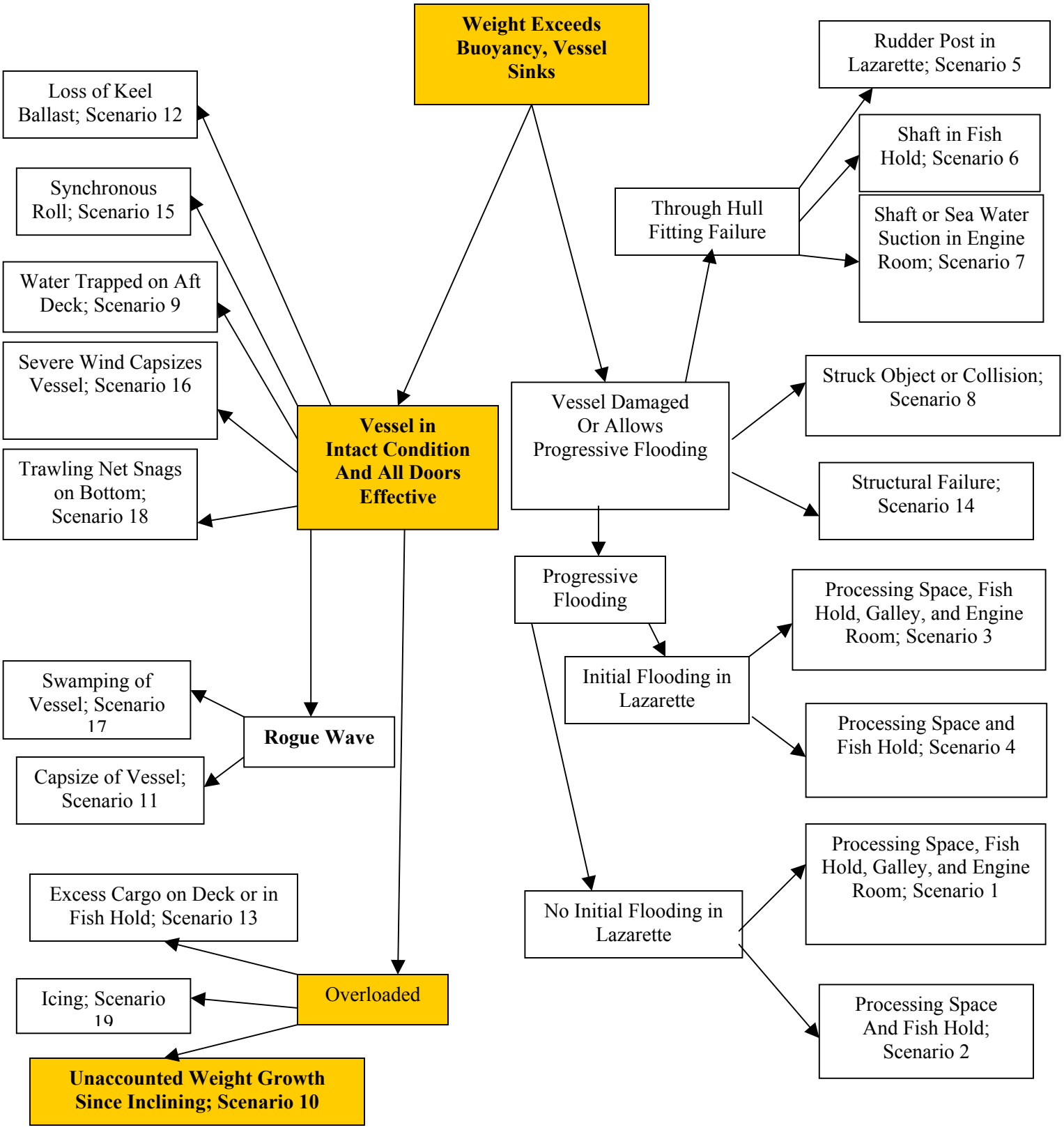
2. The Coast Guard found that the ARCTIC ROSE's stability would be severely affected by water trapped on the aft deck, as shown in attachment (1). The vessel would probably still have had a very large range of positive stability, and the vessel would probably not have capsized until it reached a heel angle of 75°. However, its ability to resist the heeling moment created by winds and waves would be reduced.

3. The Coast Guard reviewed the ROV tapes taken of the ARCTIC ROSE, and although the entire aft deck was not viewed, there was no evidence of blocked freeing ports or other signs that water would have been trapped on deck. Water would probably have been shed from the vessel through the freeing ports in the side bulwarks, the aft ramp, and forward into the processing space through the open door on the starboard side. Additionally, testimony given to the Marine Board indicates that the vessel did not trap water on the aft deck.

Conclusion

4. Although the ARCTIC ROSE's stability would be reduced by water trapped on the after deck, the large range of stability, large reserve buoyancy of the vessel, and lack of evidence that water could gather and remain trapped on deck make it unlikely that the loss of the ARCTIC ROSE was due solely to water trapped on the after deck.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 10

UNACCOUNTED FOR WEIGHT GROWTH SINCE INCLINING

Method of Analysis

1. The Coast Guard reviewed the weight changes made to the ARCTIC ROSE since the 1999 inclining performed by Jensen Maritime Consultants. The list of all major machinery added, removed, or moved from the vessel was provided by Jensen Maritime Consultants. This list was compared to the description of changes made to the vessel during testimony to the Marine Board.

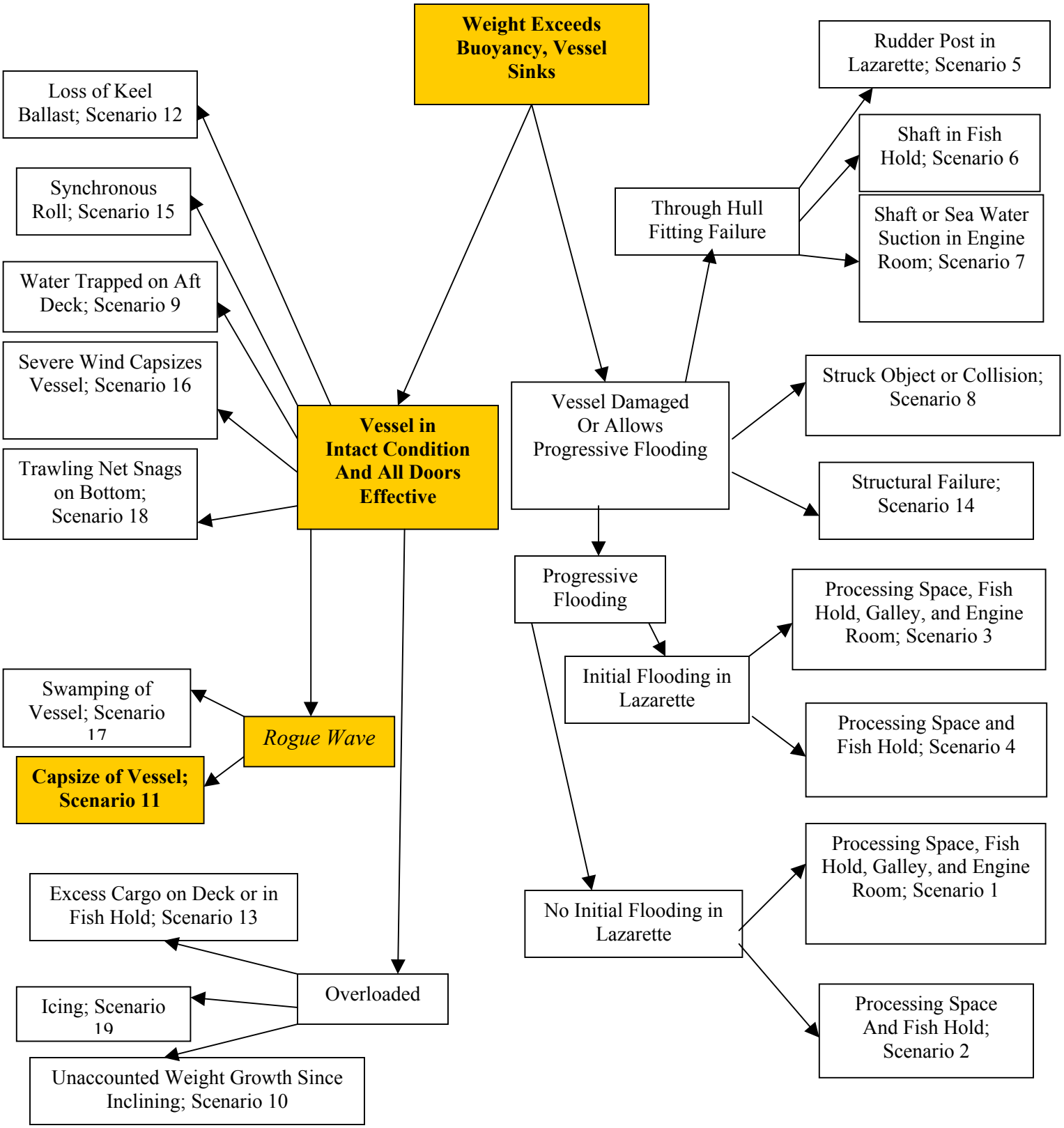
Findings

2. The Coast Guard found that the list of weight additions, subtractions, and movements provided by Jensen Maritime Consultants correlated with the testimony provided to the Marine Board.

Conclusion

3. Based on the accurate correlation between the list of weights added, removed, or moved provided by Jensen Maritime Consultants and the testimony collected by the Marine Board, the ARCTIC ROSE' stability was very likely not severely affected by unaccounted for weight growth.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 11

CAPSIZING OF VESSEL DUE TO ROGUE WAVE

Method of Analysis

1. The Coast Guard performed a one dimensional dynamic analysis on the ARCTIC ROSE to determine the minimum wave height necessary to capsize the vessel within one wave period. With the assistance of Dr. Armin Troesch, Professor in the Naval Architecture/ Marine Engineering Department at the University of Michigan, the Coast Guard used the computer program SHIPMO to calculate the added mass, viscous damping forces, and wave forces that would act on the vessel in a seaway. Using the righting arm of the vessel at the time of the casualty as the stiffness term, the roll response of the vessel was calculated over time for increasing wave heights until the wave was sufficiently large enough to roll the vessel past its angle of vanishing stability.

2. With the assistance of Dr. Bruce Johnson, Chair of the Society of Naval Architects and Marine Engineers Ad Hoc Panel on Fishing Vessel Operations and Safety, the dynamic response of the ARCTIC ROSE in a seaway was evaluated by comparing the righting arms of the vessel at the time of the casualty to the righting arms of four different vessels whose capsize resistance had been tested in model basins. The results of these four vessels' capsize resistance had been reported by Dr. Stephan Grochawalski in his paper, "Investigation Into the Physics of Ship Capsizing by Combined Captive and Free-Running Model Tests" published in SNAME Transactions, Vol. 97, pp. 169-212, in 1989. The righting arm for vessel IIB was scaled to that of the ARCTIC ROSE so that the area under the righting arm curve from 0 to the angle of vanishing stability was equal. This scaling most accurately captured both vessels' total resistance to capsizing. The wave height from the model tests for vessel IIB was then scaled the same amount to calculate the minimum size of the wave that could capsize the ARCTIC ROSE.

Findings

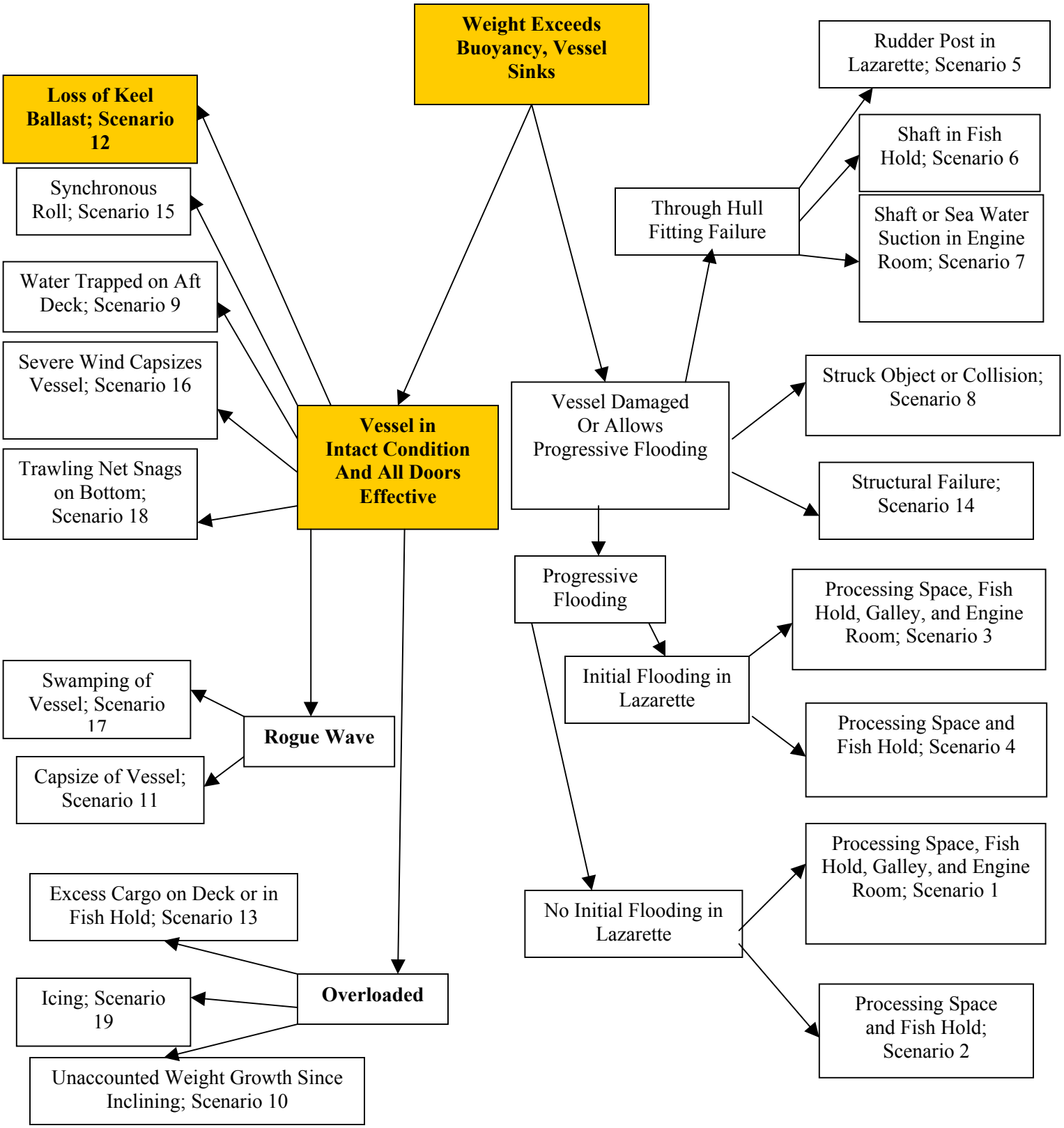
3. Using a dynamic roll analysis, it was found that it would probably take a fifty two foot wave from the beam to capsize the ARCTIC ROSE, which is more than twice the reported wave height the night of the casualty. The graph of the dynamic roll response of the vessel is included as attachment (1).

4. Using the scalable righting arms provided by Dr. Bruce Johnson, the ARCTIC ROSE would not capsize in a seaway of at least 51 feet. This correlates very well with the results from the dynamic roll analysis. The graph of the ARCTIC ROSE righting arm and the four models tested in the tow tank is included as attachment (2).

Conclusion

5. Based on the extremely large wave height calculated as necessary to cause the capsize of the ARCTIC ROSE, and the size of the seas on the night of the casualty, it is very unlikely that the loss of the vessel was due to a rogue wave.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 12

LOSS OF KEEL BALLAST

Method of Analysis

1. The Coast Guard performed a static stability analysis using GHS and the most likely assumed loading conditions at the time of the casualty. The keel ballast weight and location provided by Jensen Maritime Consultants was subtracted from the load conditions, and the resulting vessel stability characteristics were calculated and compared to the intact righting arm characteristic criteria and the severe wind and roll criteria in the regulations. Additionally, the ROV tapes were reviewed for signs of structural damage in the vicinity of the keel ballast.

Findings

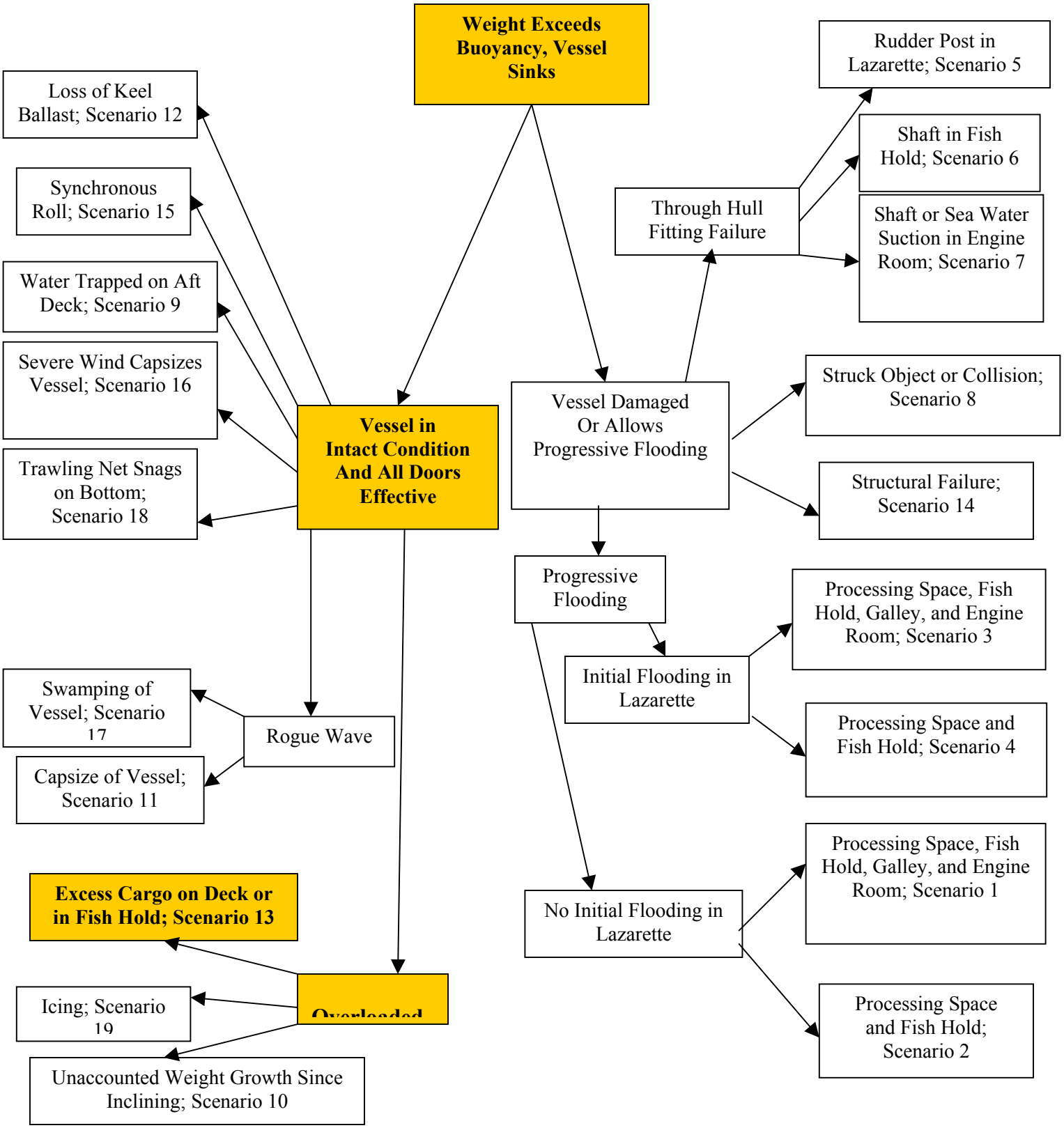
2. The Coast Guard found that the vessel's stability is only slightly affected by the loss of the 13,500 lb. bar keel, as shown in attachment (1). Without the bar keel, the vessel meets practically all the stability criteria described above, except that the metacentric height is one-eighth of an inch less than required, and the vessel will roll 2 degrees further than allowed when subjected to severe wind and waves. The angle of vanishing stability is still greater than 90°, however.

3. Review of the ROV tapes taken of the ARCTIC ROSE, did not provide an opportunity to observe the keel directly. There was no evidence of structural damage near the keel to indicate the keel ballast was no longer connected to the vessel. If the keel ballast was welded to the hull as testimony suggests, then it is very unlikely the keel ballast would come free from the vessel without causing structural damage to the vessel.

Conclusion

4. Based on the ARCTIC ROSE's stability characteristics without the keel ballast and the fact there was no evidence of structural damage around the keel area, it is unlikely that the loss of the ARCTIC ROSE was due to the loss of the keel ballast.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 13

OVERLOADED WITH EXCESS CARGO ON DECK OR IN FISH HOLD

Method of Analysis

1. The Coast Guard reviewed the amount of fish and cargo onboard the ARCTIC ROSE provided by Jensen Maritime Consultants and compared this list to the amount of cargo in the fish hold of the vessel provided during testimony to the Marine Board. The Coast Guard also reviewed the ROV video to evaluate if the vessel had been fishing at the time of the casualty.

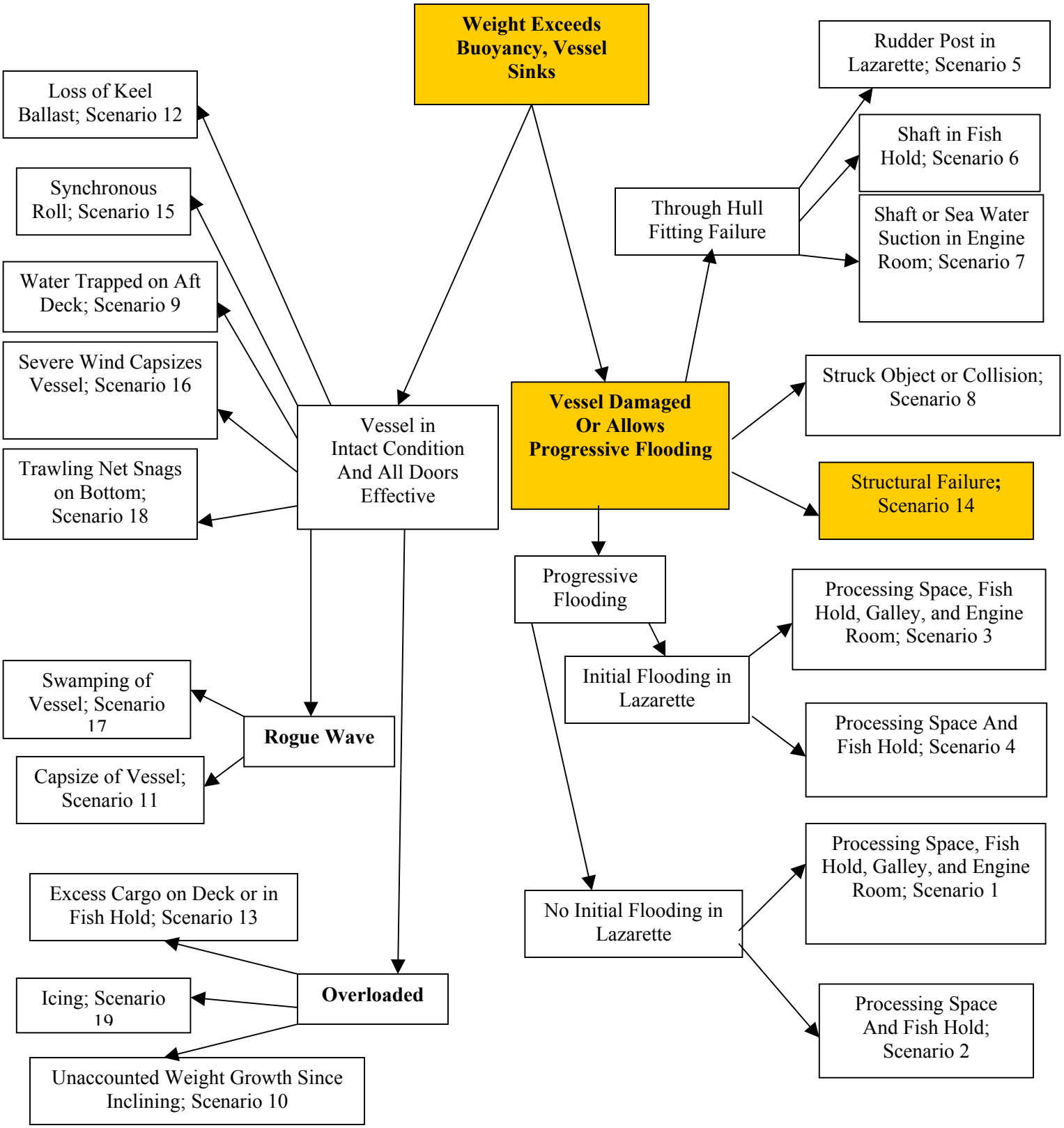
Findings

2. The amount of cargo in the fish hold was significantly less than the maximum the vessel could carry. Additionally, the vessel does not appear to have been fishing at the time of the accident, and although the vessel had a codend that could hold 20,000 pounds of fish, there was probably very little fish on deck or in the processing space at the time of the casualty.

Conclusion

3. Based on the cargo loads provided to the Coast Guard by the Marine Board of Investigation and the ROV video, it is very unlikely the loss of the ARCTIC ROSE was due to the vessel being overloaded with excess cargo on deck or in the fish hold.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 14

STRUCTURAL FAILURE

Method of Analysis

1. The Coast Guard reviewed the ROV video of the ARCTIC ROSE to evaluate the possibility of a global structural failure that would cause the loss of the vessel. In addition, the Coast Guard reviewed the ROV tapes for the F/V ITALIAN GOLD, which sank due to a global structural failure at amidships in 1994, to compare the video results.

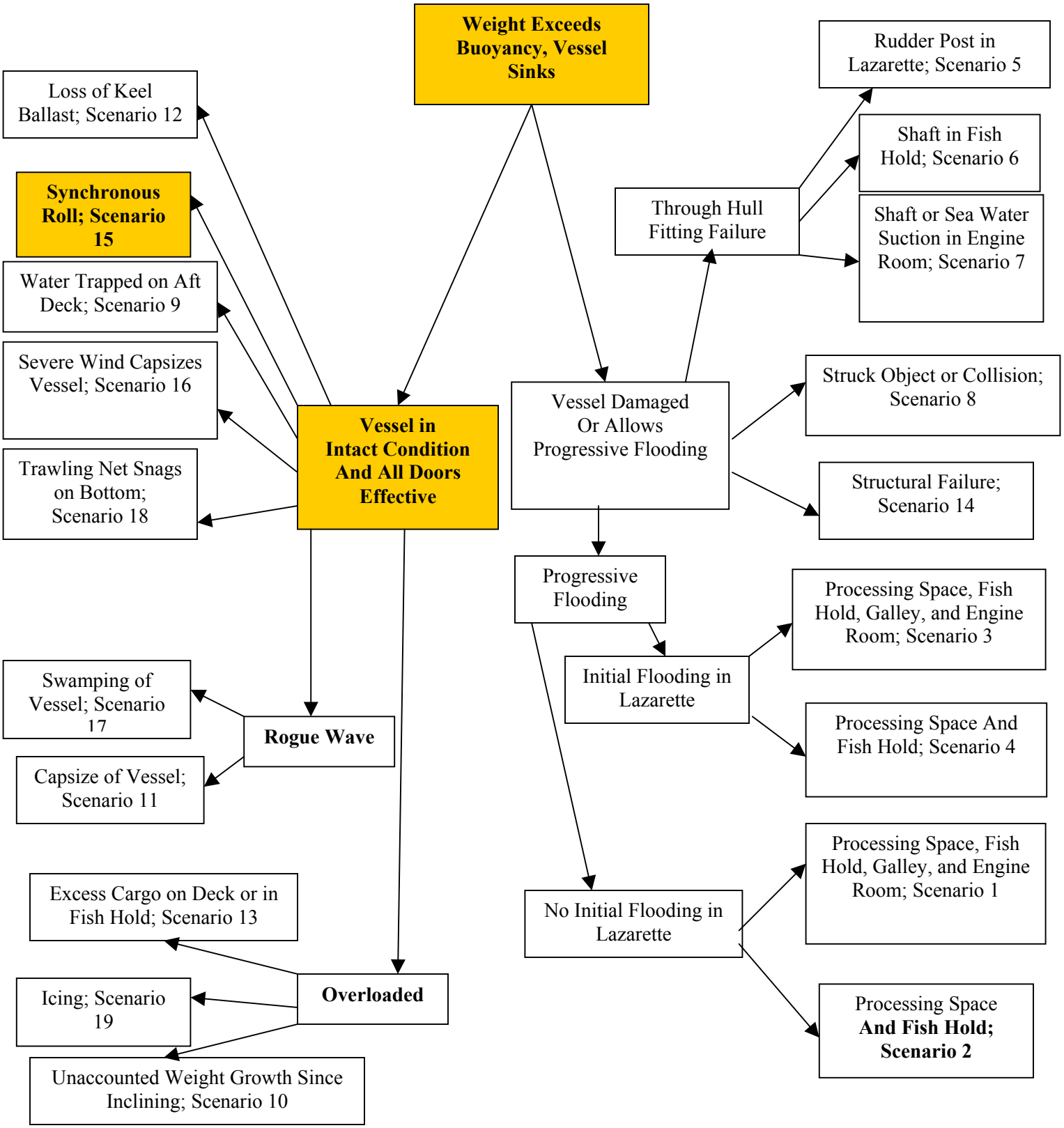
Findings

2. The Coast Guard found no evidence of a global structural failure of the ARCTIC ROSE when the ROV video was reviewed. Additionally, there was no evidence of structural modifications performed on the vessel or fatigued plates that would weaken the strength of the vessel. It was apparent from the ITALIAN GOLD video that any global structural failure would be evident in buckled plating and cracks in the side shell.

Conclusion

4. Based on the ROV video of the ARCTIC ROSE side shell, deck plating, and bottom plating, it is very unlikely that the vessel sank due to a global structural failure.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 15

SYNCHRONOUS ROLL

Method of Analysis

1. The Coast Guard analyzed the possibility of the ARCTIC ROSE capsizing due to synchronous roll in a seaway. With assistance of Dr. Armin Troesch, Professor in the Naval Architecture/Marine Engineering department at the University of Michigan, the Coast Guard employed the computer program SHIPMO to calculate the natural frequency of the vessel in the roll direction. The natural frequency calculation is based on the hull form of the vessel, and the displacement and centers of gravity of the vessel. The Coast Guard then used the Nomograph for Determining Conditions for Synchronous Oscillation in Regular Waves, Figure 78 in Principles of Naval Architecture, Volume III, to establish the vessel heading and speed at which synchronous roll could have occurred.

Findings

2. The natural period of the ARCTIC ROSE in the roll direction was about 7.76 seconds, which is equivalent to a natural frequency of .81 radians per second.

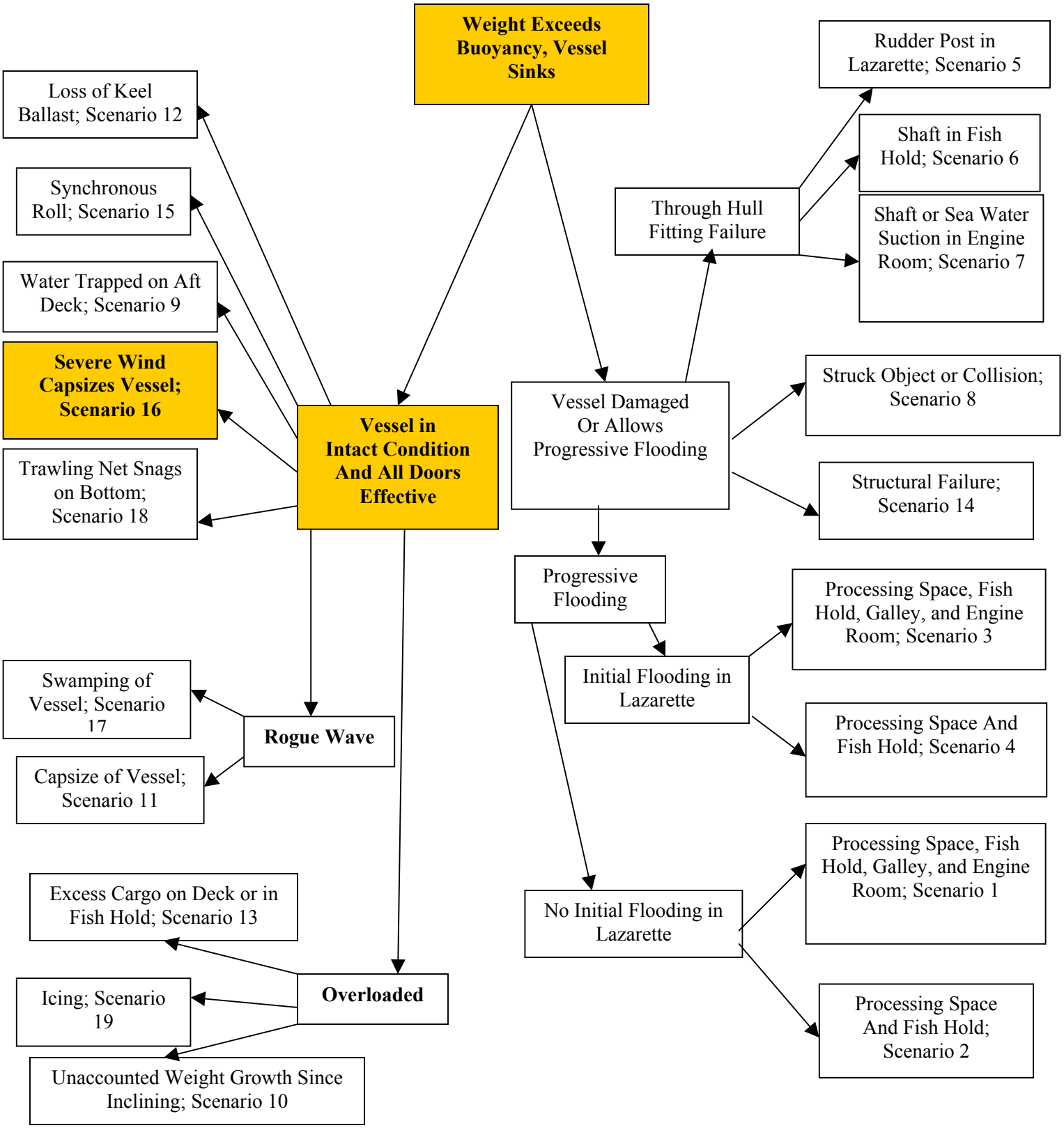
3. Using the nomograph, attachment (1), and inputting a natural period of 7.76 seconds and a wave length of 512 feet, corresponding to a wave period of ten seconds, the ARCTIC ROSE would have to travel at least ten knots in head seas directly on the bow for the vessel to encounter conditions in which synchronous rolling may occur. As the relative heading between the vessel and the sea increases, and the vessel encounters seas off the bow towards the beam, the ship's velocity would have to increase to over twelve knots if the synchronous rolling conditions were to exist.

4. Information provided to the Marine Board suggests it is very unlikely the ARCTIC ROSE was in a regular seaway at the time of the loss. Additionally, the vessel may have been jogging to maintain position during the night, and therefore not traveling at six knots, the minimum speed for which the conditions for synchronous oscillation could occur.

Conclusion

4. Based on the roll characteristics of the ARCTIC ROSE, the weather conditions the night of the vessel's loss, and the probable speed of the vessel, it is very unlikely that the loss of the ARCTIC ROSE was due to synchronous roll.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 16

SEVERE WIND CAPSIZES VESSEL

Method of Analysis

1. The Coast Guard performed a static stability analysis of the ARCTIC ROSE using GHS and the most likely assumed loading conditions at the time of the casualty to evaluate the wind speed necessary to capsize the vessel. The Coast Guard increased the wind heeling moment applied to the vessel until the ARCTIC ROSE no longer met the Severe Wind and Roll Criteria listed in reference (b).

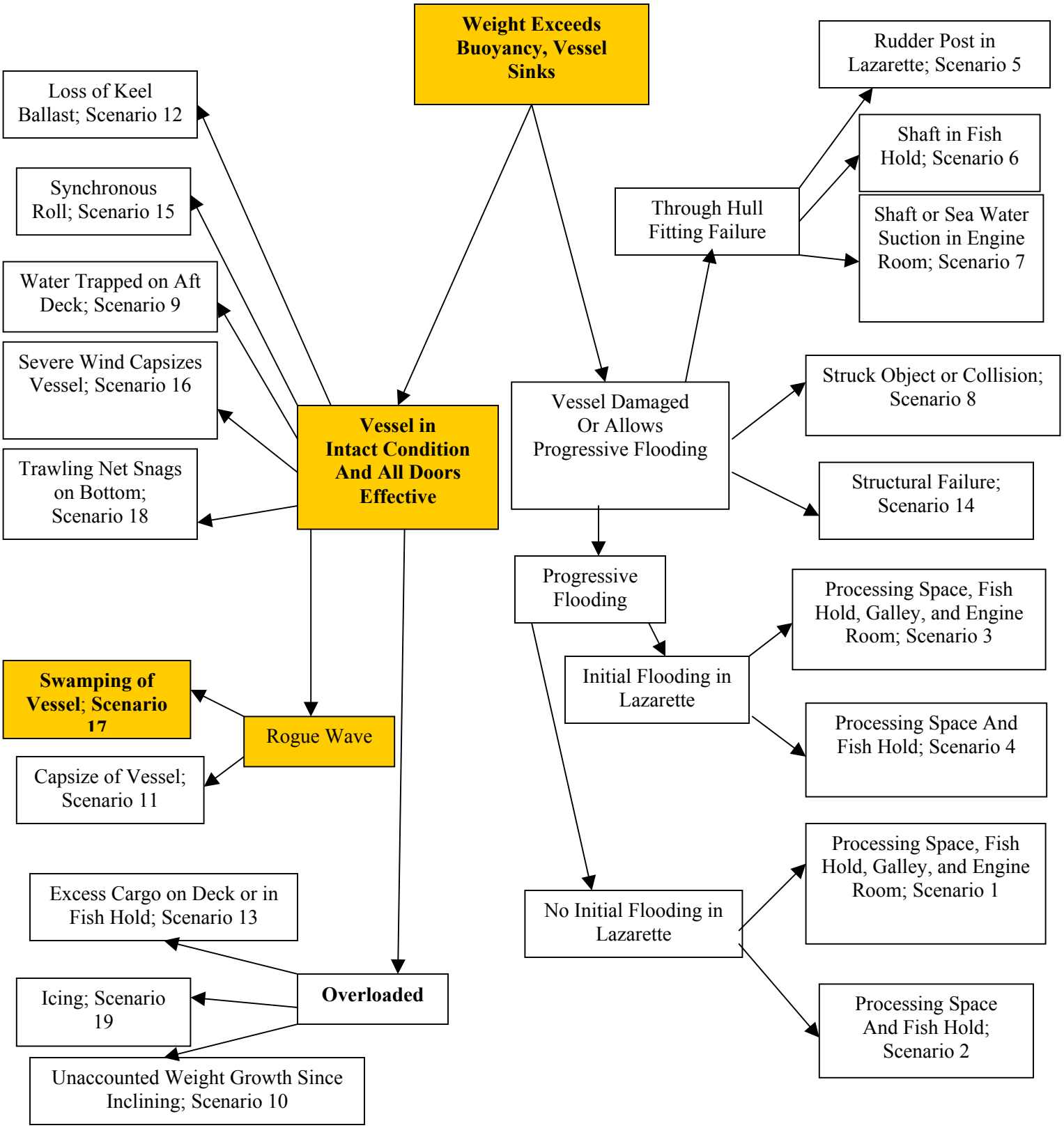
Findings

2. The Coast Guard found that the ARCTIC ROSE would meet the area requirements for Severe Wind and Roll when a 100 knot wind was applied to the vessel, as shown in attachment (1). Additionally, the vessel would only heel over to 30°, which is more than 50° from the angle of vanishing stability.

Conclusion

4. Based on the ARCTIC ROSE's stability characteristics when a 100 knot wind was applied, it is very unlikely that a severe wind would heel the vessel past its angle of vanishing stability and capsize the vessel.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 17

SWAMPING OF VESSEL DUE TO ROGUE WAVE

Method of Analysis

1. The Coast Guard performed a static analysis to evaluate the possibility of the ARCTIC ROSE being swamped by a rogue wave so that all reserve buoyancy was lost due to the extreme amount of water deposited in the vessel. The Coast Guard calculated the reserve buoyancy of the vessel, and then used flowrate calculations to evaluate how quickly the water would enter the processing space and aft deck.

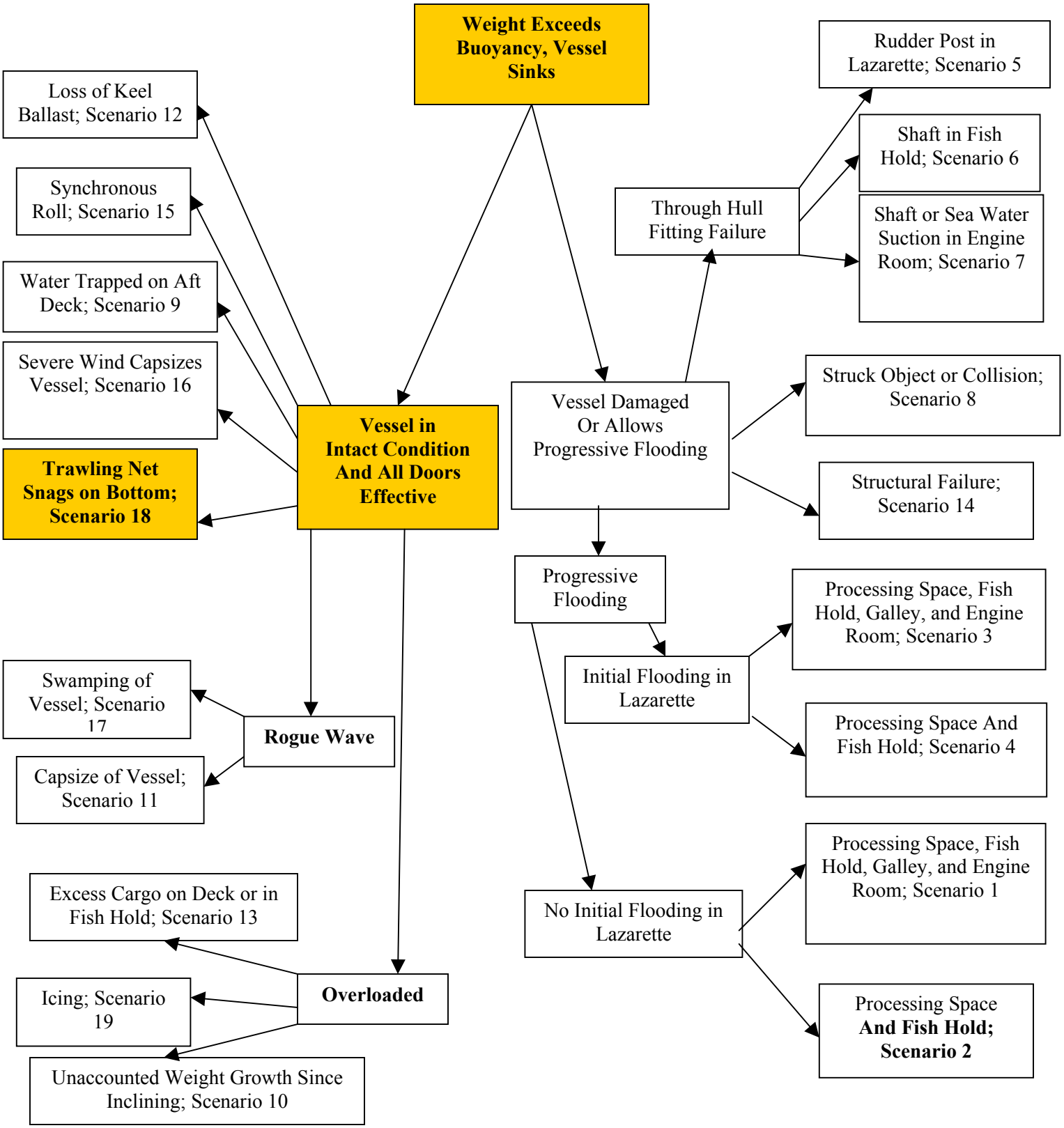
Findings

2. The ARCTIC ROSE had approximately 500 tons of reserve buoyancy. Therefore, a rogue wave would have to deposit approximately 17,500 cubic feet of water on the aft deck and in the processing space. The aft deck could hold only about 1000 cubic feet before the water would wash over the bulwarks. For the remaining water to enter the processing space through a 3 foot by 5 foot door and swamp the vessel, the water contained in the rogue wave would have to travel at well over 1000 feet per minute.

Conclusion

3. Based on the extremely large volume of water that would be needed to swamp the ARCTIC ROSE, the small aft deck area, and the relatively small door opening through which water could enter the processing space, it is very unlikely that a rogue wave swamped the vessel and caused it to sink.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 18

TRAWLING NET SNAGS ON BOTTOM

Method of Analysis

1. The Coast Guard reviewed the ROV video taken of the ARCTIC ROSE to evaluate if the vessel was trawling at the time of the casualty.

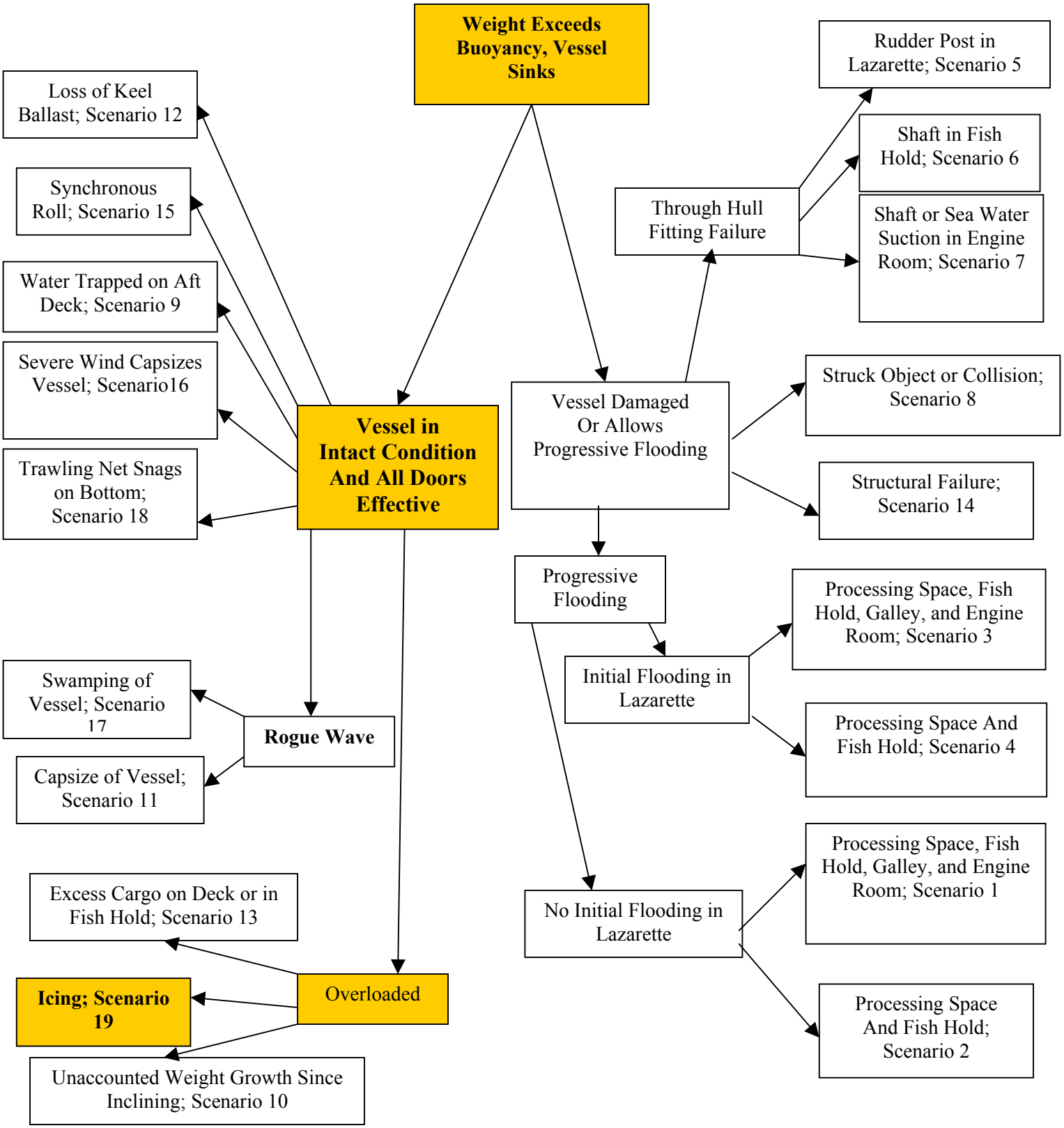
Findings

2. The Coast Guard found that the trawling net appears to be stowed on the aft reel, and that the ARCTIC ROSE was probably not fishing at the time of the accident. The trawling net probably did not submerge the vessel's stern by snagging on the bottom.

Conclusion

3. Based on the ROV video which shows the trawling net stowed on the aft reel, it is very unlikely that the ARCTIC ROSE sank due to the trawling net snagging the bottom and dragging the aft end of the vessel down.

SCENARIOS THAT COULD LEAD TO THE LOSS OF THE F/V ARCTIC ROSE



SCENARIO 19

OVERLOADED DUE TO ICING

Method of Analysis

1. The Coast Guard analyzed the possibility of the ARCTIC ROSE capsizing due to icing by reviewing the sea ice analysis performed by NOAA and testimony given to the Marine Board.

Findings

2. The sea ice analysis performed by NOAA indicated the edge of the sea ice was well north of the ARCTIC ROSE the evening of the casualty. Additionally, testimony from vessels only 12 nautical miles from the ARCTIC ROSE indicated that no icing was occurring the night of the casualty.

Conclusion

3. Although icing of the ARCTIC ROSE would reduce the stability of the vessel, the lack of evidence of icing the night of the casualty makes it very unlikely that the loss of the ARCTIC ROSE was due to icing.

Appendix 4

ROV EXPEDITIONS

The Marine Board faced a daunting task of trying to recreate/reconstruct the ARCTIC ROSE at the time of her sinking. This task was complicated by the following items:

1. There were no survivors of the disaster.
2. There were no existing plans of the vessel.
3. There were no eye witnesses of the disaster.
4. The ARCTIC ROSE did not make a MAYDAY call to notify surrounding vessels of any problems.

The Marine Board felt it was important to locate the wreck of the ARCTIC ROSE and conduct a survey of the vessel in search of clues to help identify the proximate cause of the casualty. The Board Chairman petitioned Coast Guard Headquarters in Washington, D.C. for permission and funding to carry out an expedition to locate and conduct underwater surveys of the vessel through the use of an ROV. The Coast Guard Headquarters granted the Board's request and two expeditions were ultimately organized to locate and survey/video tape the condition the wreck of the ARCTIC ROSE.

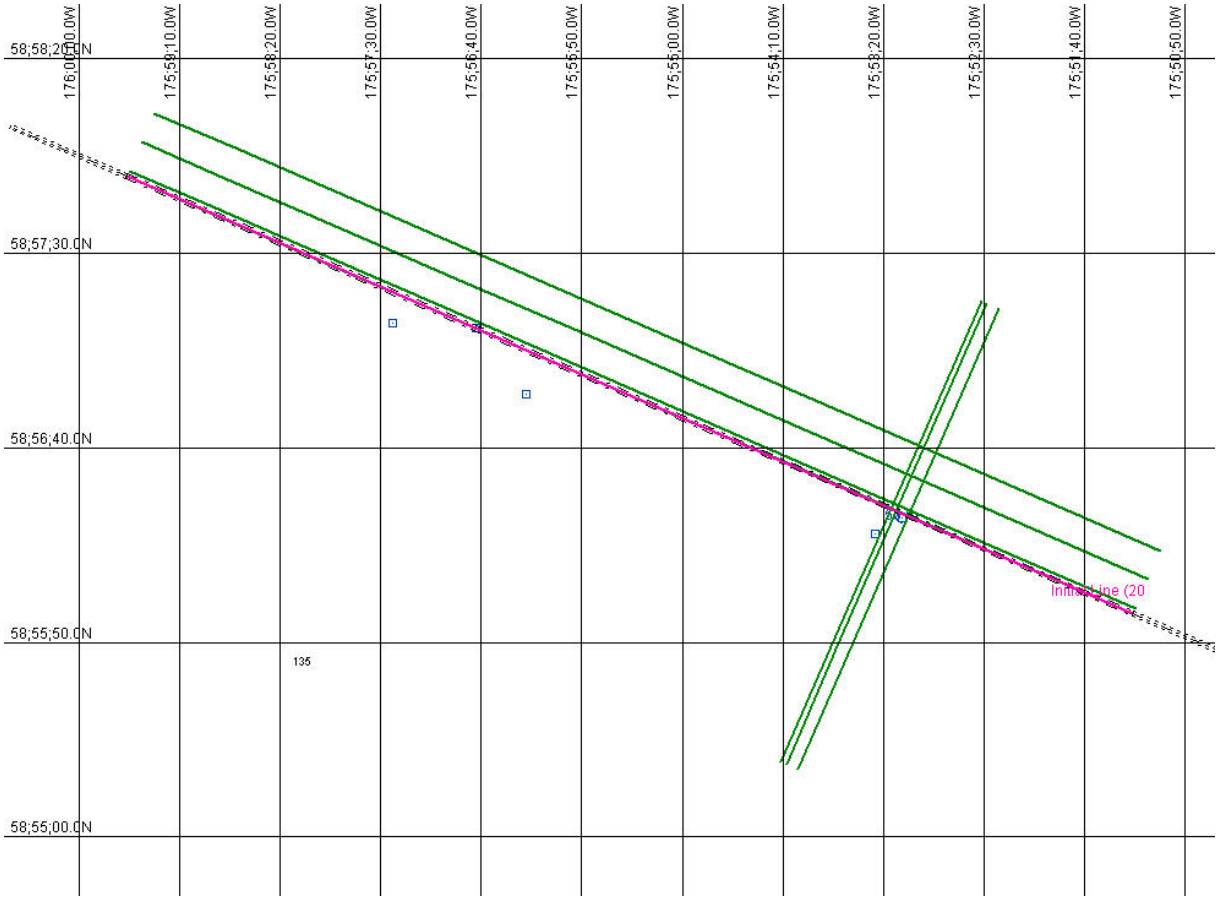
The Marine Board organized various contractors to provide a suitable vessel to use as a platform for the ROVs and their support teams. The Marine Board was fortunate to locate a vessel, the M/V OCEAN EXPLORER, (see above figure) equipped with a KLEIN 5000 sonar array, already under charter to NMFS and ready for deployment. The M/V OCEAN EXPLORER is a 140 ft, 896 GT, pelagic or mid-water trawler operated by B & N Fisheries, Seattle, Washington.

The Klein 5000 is an extremely sensitive side-scanning sonar with the ability to detect minute objects or details on the sea floor. The Klein 5000 System consists of a Towfish, Tow Cable, a Transceiver/Processor Unit, and a PC for system control and data viewing. The stainless steel towfish incorporates two multi-channel acoustic arrays and a pressure bottle, which houses all of the electronics and sensors necessary for sonar acquisition, altitude sensing, system control, and telemetry. The sonar and sensor data is transmitted up the tow cable via a high-speed digital telemetry link, requiring only a single coaxial or fiber-optic cable. The surface mounted Transceiver /Processor Unit receives the data,

performs all necessary digital processing functions on this data, and relays control commands to the towfish. It requires a team of two for its operation, one technician to fly the "fish" underwater and a other technician to monitor the sonar picture. The Klein 5000 system and her crew proved to be critical in locating the ARCTIC ROSE. The equipment for the sonar array was located in a small space located just forward of the engineroom of the M/V OCEAN EXPLORER. This space became the operations center for the search.

The voyage from Unalaska, Alaska to the search area took approximately two days. During that time the expedition team readied their equipment and developed a comprehensive search plan. The Marine Board provided known locations of the composite EPIRB hit, debris field, oil slick, and liferaft to the sonar team who used the information to build a search grid and the search pattern. The team integrated technology of a Triton Elics International Isis Sonar digital acquisition system with a side-scan sonar Klein 5000 towed fish. Data from the Klein 5000, known as a "towfish," was transmitted up 300 meters of tow cable.

Once on-scene the M/V OCEAN EXPLORER conducted a pass on the initial trackline using its bottom scanning sonar to check for any possible snags so as not to entangle or damage the Klein 5000. At 0330, during the third sonar pass, a large target was found. Subsequent passes revealed a silhouette that matched the profile of the ARCTIC ROSE.



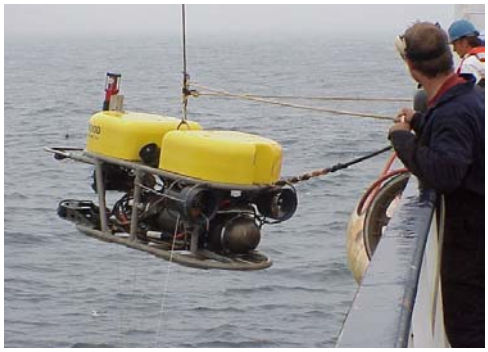
Using these techniques, the team located the wreckage and identified the ARCTIC ROSE soon after the start of the search. The ARCTIC ROSE lies at a 428 feet depth, 200 miles northwest of St. Paul Island in the Bearing Sea. It took the team only two hours from putting the towfish in the water to locate the vessel. The team made several passes to resolve the image at the bottom and look for any debris that may entrap the ROV.

At 0700 the crew was awakened and mustered on the deck of the OCEAN EXPLORER. The Marine Board held a brief memorial ceremony to commemorate the crew of the ARCTIC ROSE. Upon completion of the ceremony a wreath was tossed into the water in their honor.

Shortly after the ceremony the ROV Phantom HD2 was readied, lowered into the water and operationally tested. The ROV motored along the bottom with its video camera sending pictured to the surface (these images were recorded for the Marine Board). A hull came into view, the ROV went along the side of the hull rising as it traveled. Finally, letters came into view, confirming the ARCTIC ROSE was located. The ROV was at the port bow of the vessel and proceeded towards the pilothouse. The video showed the Marine Board that the vessel was resting upright with a slight starboard list on the sea floor. The ROV attempted to power towards the stern of the vessel but it became hopelessly tangled in loose net mending twine and was lost when the umbilical parted in a last ditch attempt to free it. The Marine Board received approximately fourteen minutes of usable video. The Klein 5000 was placed back into service and the OCEAN EXPLORER made several close passes of the wreck hoping to obtain any additional clues into the sinking of the vessel. The expedition returned to Unalaska, disappointed it did not fully survey the vessel.

The Marine Board received permission from Coast Guard Headquarters to prepare a second expedition to survey the wreck of the ARCTIC ROSE.

On August 20, 2001, the second expedition departed Unalaska aboard the M/V OCEAN EXPLORER with a larger, more powerful ROV to return to the ARCTIC ROSE and complete its mission. The MAXROVER was equipped with stronger thrusters and a robotic arm which could be used to cut the ROV free from debris.



The team arrived on-scene on August, 22, 2001, but rough sea conditions forced the team to wait for better operating conditions. After loitering for several days, the weather calmed falling within the minimum weather window for safe ROV operations. The ROV was lowered over the side and operationally tested. The MAXRover descended to the wreck. The video camera was activated and filmed the wreckage for clues. The MAXRover completed five dives and surveys of the wreckage. The Marine Board was able to examine the entire stbd hull, stern/transom area, the trawl deck along with all associated equipment, and the exterior of the processing space. The Marine Board was also able to view the aft port section of the hull, keel cooler, shaft, kort nozzle and rudder. The Marine Board was able to learn a great deal about the vessel and its condition.

The Marine Board discovered the following details concerning the vessel:

1. No hull failure or excessive corrosion,
2. No damage or indication that the vessel was rammed or struck an object prior to the sinking,
3. No buckled decking or side shell insets,
4. The vessel's rudder was hard over to port,
5. The vessel appeared to strike the bottom stern first,
6. The aft weathertight door to the processing space was open,
7. A starboard guillotine closure for the by-catch overboard discharge chute was open,
8. Heavy gear was strewn across the deck and resting over the starboard bulwarks of the vessel,
9. The vessel's trawl doors are missing,
10. The vessel's trawl net was on the net reels, and;
11. The vessel's propeller and shaft were in place.

The discovery of these facts allowed the Marine Board to discount or eliminate many theories as to why the vessel sank. Certain facts did raise a few questions, especially the missing trawl doors. However, the facts did provide more answers than questions and assisted the Marine Board to arrive at the most probable cause of the casualty.

In closing, the Marine Board would be remiss if it did not acknowledge the skills and talents of the crew of the M/V OCEAN EXPLORER, technicians from Triton Helix, Marine Consultants Inc., without whose cooperation and teamwork during the expeditions the Marine Board would not have been able to complete their investigation of the sinking of the ARCTIC ROSE.