U.S. Department
of Transportation

**United States
Coast Guard**

MARINE CASUALTY REPORT

FISHING VESSEL AMERICUS, O.N. 595758,

CAPSIZING AND SINKING —

FISHING VESSEL ALTAIR, O.N. 618390, DISAPPEARANCE ON OR ABOUT 14 FEBRUARY 1983 IN THE BERING SEA WITH PRESUMED MULTIPLE LOSS OF LIFE

U.S. COAST GUARD

Marine Board of Investigation Report
and
Commandant's Action

REPORT NO. USCG 16732/0002 HQS 83

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16. Abstract

At 0230, February 14, 1983, the fishing vessel ALTAIR departed Dutch Harbor, Alaska enroute to the crab fishing grounds in the vicinity of the Pribilof Islands. The fishing vessel AMERICUS followed six hours later. Both vessels were loaded with crab pots. A fishing vessel returning to Dutch Harbor from the Pribilofs made visual contact with the ALTAIR and passed within 150 yards at around 0330 approximately 20 miles northwest of Dutch Harbor. The next contact with the vessels was made by a freighter at 1510 February 14, 1983, when a capsized hull (later identified as the AMERICUS) was observed about 25 miles northwest of Dutch Harbor. The hull did not appear to have been damaged and continued to float until 1130 February 16, 1985. On March 16, 1983, an inflatable life raft from the ALTAIR was found at a location approximately 11 miles from where the AMERICUS hull was initially observed. This was and remains the only sighting from the ALTAIR. The seven-man crews from each vessel remain missing and are presumed dead. The observations of the AMERICUS in a capsized state with no apparent damage, the lack of distress signals from either vessel, the failure of the search effort to locate anyone in survival suits tend to support the conclusion that both vessels capsized rapidly and without warning. The Commandant has concurred with the Board that the proximate cause of these casualties is improper loading.

This report contains the U. S. Coast Guard Marine Board of Investigation Report and the Action taken by the Commandant to determine the proximate cause of the casualty and provide a response to the recommendations to prevent recurrence.

17. Key Words:	18. Distribution Statement
Stability, lightship displacement, inclining, cross-tanked, drag gear, crab boat, crab pots, stability criteria, deadweight survey, boot stripe, metacentric height, vertical center of gravity, longitudinal center of gravity	This document is available to the public through the National Technical Information Service, Springfield, Virginia 22151

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FISHING VESSEL AMERICUS, O.N. 595758, CAPSIZING AND SINKING - - FISHING VESSEL ALTAIR, O.N. 618390, DISAPPEARANCE ON OR ABOUT 14 FEBRUARY 1983 IN THE BERING SEA WITH PRESUMED MULTIPLE LOSS OF LIFE

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16732/AMERICUS/ALTAIR

19 JUL 1985

Commandant's Action

on

The Marine Board of Investigation convened to investigate the circumstances surrounding the capsizing and sinking of the F/V AMERICUS with the disappearance of the F/V ALTAIR on or about February 14, 1983 with presumed multiple loss of life.

The report of the marine board of investigation convened to investigate the subject casualty has been reviewed and the record, including the findings of fact, conclusions and recommendations, is approved subject to the following comments:

REMARKS

In concurrence with the board, the proximate cause of these casualties is improper loading. The observations of the AMERICUS in a capsized state with no apparent damage, the lack of distress signals from either vessel, the failure of the search effort to locate anyone in survival suits tend to support the conclusion that both vessels capsized rapidly and without warning. Despite diligent efforts by the board, the true stability characteristics of the vessels at the time of the casualty cannot be determined due to possible inaccuracies in their lightship and loaded conditions. In the case of the AMERICUS the facts support the conclusions that there were 227 crab pots on board and that the crab tanks were cross tanked. Loaded in this condition and utilizing the smallest projected weight gain, the vessel did not meet the criteria established in the International Maritime Organization (IMO) Resolution A. 168(ES.IV), more commonly known as the Torremolinos Convention Criteria, and hereinafter referred to as the IMO criteria. Even if the double bottoms fuel tanks were pressed full (a more favorable condition), the AMERICUS failed to meet the IMO criteria regarding minimum value of righting arms at 30 degrees and the minimum angle of maximum righting arm. In the case of the ALTAIR, the facts support that there were 224 crab pots on board and all four crab tanks were filled. Again, utilizing the smallest weight gain, the stability of the ALTAIR would have been significantly less than the AMERICUS.

A contributing cause of the casualty was the failure to re-evaluate the stability information for each vessel to account for the drag gear conversions and the weight gain above and beyond the drag gear conversions. The need to more thoroughly evaluate the stability following the second and third conversions should have been evident from the calculations provided by Mr. Jacob Fisker-Andersen after the first conversion on the ALYESKA which reduced the allowable number of crab pots from 258 to 228. Had a deadweight survey been conducted following the drag gear conversions the additional increase in the vessel's displacement above the drag gear conversions would have been detected.

COMMENTS ON CONCLUSIONS

1. Conclusion 9: The following factors are identified as having contributed to apparent unstable conditions on board AMERICUS and ALTAIR.

   a. Drag gear conversion

   b. Apparent weight gain above and beyond the drag gear conversion

   c. Crab tank flooding

   d. Fuel distribution

The carriage of crab pots, adding approximately 70 tons to each vessel, also had a negative impact on stability, but is not categorized as contributing to instability since crab fishing was the service of the vessels.

Comment: This conclusion is concurred with in part. That the first four factors contributed to the instability of the vessel is concurred with. However, the loading condition must be evaluated in its entirety. The number and distribution of the crab pots were not appropriate for the vessel loaded with the double bottom fuel tanks empty and the crab tanks either cross tanked or full. Thus, the crab pots must also be considered as contributing to the instability of the vessel.

2. Conclusion 15: The presence of the drag gear on board and the existence of other weight in addition to the drag gear constituted fixed conditions over which the AMERICUS and ALTAIR masters had no control. Decisions with respect to how the vessels were loaded, specifically regarding fuel distribution and crab tank flooding, were factors under the immediate and direct control of the respective masters.

Comment: This conclusion is concurred with. It is imperative that the master operate his vessel using the stability information provided. If the master does not understand the stability information provided he should seek additional guidance. If the master or the owner intends to operate the vessel in conditions which are not addressed in the stability information they should consult with a naval architect to ensure safe loading under these conditions.

3. Conclusion 17: Corroborating information on the AMERICUS fuel distribution is gleaned from Mr. Brenengen's testimony indicating the AMERICUS engineer planned commencing his transfer "from a front tank with 8,000 or 10,000 gallons." There is not a front tank with 8,000 or 10,000 gallons on the AMERICUS, or any of her sister vessels. The record of the 13 February 1983 transfer of fuel from the ALYESKA (board exhibit No. 73) refers to the No. 1 port and starboard double bottom tanks as "the forward crab tank" - one tank. The No. 1 port and starboard double bottom tanks on AMERICUS, when full, hold 8,040 gallons. It is felt the AMERICUS engineer's comment referred to the forward double bottom tanks.

Comment: This conclusion is concurred with. However, referring to exhibit 161, the three double bottom tanks aboard the ALYESKA are each one tank and are not configured as port and starboard tanks.

4. Conclusion 22: Had the AMERICUS and ALTAIR sailed with full double bottom tanks and empty crab tanks, these casualties would not have occurred. To that end, improper loading is concluded to be the proximate cause of these casualties.

Comment: This conclusion is concurred with in part. Having full double bottom tanks and empty crab tanks would have significantly improved the stability characteristics of the vessel and would have enabled the vessel to meet the IMO criteria. However, even that does not guarantee that the vessels would not have capsized.

5. Conclusion 24: The IMO criteria published in Navigation and Vessel Inspection Circular (NVIC) 3-76 provides an adequate margin of safety for fishing vessels. However, it is clear satisfying the initial GM criterion of 1.148 feet is the least important of that criteria and, to be meaningful, GM should be figured in terms of how Mr. Fisker-Andersen defines "required GM."

Comment: This conclusion is not concurred with. With regard to the required GM, Mr. Fisker-Anderson defines GM as that necessary to ensure that all parts of the IMO criteria are met. While this may be proper for the vessels he has designed, it is pointed out that in any multi-part criteria different parts of the criteria may govern for different hull forms. A vessel that meets all the other parts of the criteria would not automatically meet the required GM.

Although NVIC 3-76 is considered to be a good criterion, there have been vessels which reportedly met this criteria that have capsized while in the light condition. Therefore, designers should use this criterion but increase the appropriate portions of it when specific design or operational aspects may require such action.

ACTION CONCERNING THE RECOMMENDATIONS

1. Recommendation 1: It is recommended that the Commandant republish Navigation and Vessel Inspection Circular (NVIC) 3-76, reiterating the IMO criteria for fishing vessel stability, and suggesting the following additional practices:

a. Incline all newly constructed vessels, or incline the first of a class and then conduct deadweight surveys on the remaining vessels of the class.

b. Follow policy stated in paragraph 55, Findings of Fact, regarding inclines or deadweight surveys for vessels modified.

c. Re-evaluate, by incline or deadweight survey, lightship parameters of vessels periodically, particularly during the first few years of service (i.e., two years and five years after construction).

d. Adopt a modified loadline system, based on the calculated waterline at common operating conditions, to visibly define minimum required freeboard.

e. Emphasize strict adherence to stability letters and booklets.

Action: This recommendation is concurred with in part. The Coast Guard has published a new NVIC containing voluntary stability guidelines for fishing vessels. Parts (a), (b) and (e) of this recommendation have been incorporated in this NVIC.

Part (c) is not concurred with. Although the intent of this recommendation is concurred with, conducting an inclining or deadweight survey at specific time intervals may be unnecessary and costly in some cases and not timely enough in others. Instead the NVIC recommends that operators maintain a record book of draft marks for a specific loading condition. When the draft marks exceed those originally recorded by more than 2 inches, the operator should then ask for a new stability analysis.

Part (d) is not concurred with. The load line marks by themselves are not an adequate indicator of the vessel's stability. Consideration must also be given to the manner in which the vessel is loaded. Unlike cargo vessels and tankers which load only while at sheltered locations, fishing vessels load their "cargo" while at sea. Thus the proposed load line would have limited use to those most affected, namely the operator and crew. As an alternative, simplified methods are proposed for the operator to evaluate the stability of his vessel in the NVIC on fishing vessel stability. These include a pictorial format where pre-calculated conditions are shown on a profile and plan view of the vessel, a tabular format which also shows pre-calculated loading conditions that are acceptable, and a simplified trim and stability book.

2. Recommendation 2: It is recommended that the Commandant consider seeking authorization to promulgate minimum competency standards and require licenses for the masters of commercial fishing vessels of a minimum length/or tonnage. These standards could be established by a cooperative effort involving the Commandant's Fishing Vessel Safety Initiative Task Force, Fishing Vessel Safety Centers, and various local organizations of commercial fishermen. Meeting minimum competency standards could perhaps best be accomplished by documenting minimum required experience and successfully completing a Coast Guard approved course, or taking a Coast Guard prepared examination in lieu of the approved course.

Action: This recommendation is concurred with. In February 1984, the Commandant recommended a Fishing Vessel Safety Initiative to the Secretary of Transportation to reduce the number of casualties in the uninspected commercial fishing vessel fleet. The Secretary endorsed the initiative and program development began in the spring of 1984. The Coast Guard established a Task Force to study how best to reduce the number of uninspected commercial

fishing vessel casualties. A two-pronged approach was chosen, one of which includes a Safety Awareness/Education program. The Task Force considered a number of alternatives for implementing the safety initiative. One alternative included the licensing of masters and mates on uninspected commercial fishing vessels. The voluntary program of Safety Awareness/Education was chosen as a viable alternative to mandatory licensing. The Coast Guard is convinced that for this particular class of vessel and personnel, a voluntary program can provide an equivalent degree of safety.

The Safety Awareness/Education program consists of the development and dissemination of a Safety Guide. It is scheduled to be ready for distribution to the commercial fishing fleet in April of 1986. The guide will be a booklet with chapters presented in pictures, diagrams and language tailored for fishermen. The guide is being developed in a joint effort between the North Pacific Fishing Vessel Owner's Association and the Coast Guard Task Force. Further, the Coast Guard will encourage private institutions such as the NOAA/Sea Grant sponsored Fishing Vessel Safety Centers to develop courses using the Safety Guide as a course outline. These local institutions will be able to expand on the content of the guides and offer the course at the local level, tailored for the particular fishery concerned.

This voluntary approach will lead to an improvement in the professional knowledge of all crew members rather than just the master and mate. This program can be implemented in a short time and have an immediate impact on vessel safety. Being voluntary it would require no legislation and would have no disruptive effect on industry. The overall situation has created an atmosphere where a voluntary program can be effective in reducing casualties and losses.

3. Recommendation 3: The results of this investigation do not provide a basis for recommending fishing vessels be inspected by the Coast Guard. However, the potential of a non-regulatory method for upgrading industry practices exists in disseminating information, such as that which may arise from recommendations 1 and 2, to insurance companies which underwrite fishing vessels. Insurance companies, by imposing certain requirements or conditions upon which coverage is made available, are in a position to dramatically promote the cause of fishing vessel safety.

Action: This recommendation is concurred with. In addition to the Safety Awareness/Education program described above, the Coast Guard is also pursuing a voluntary Fishing Vessel Standards program. The Voluntary Standards program will consist of a series of five Navigation and Vessel Inspection Circulars to be published by the Coast Guard by August 1985. They are technical in nature and will be aimed more at the fishing vessel designer, builder, and owners rather than the operators, and will focus on such subjects as stability, construction, machinery and electrical equipment, fire protection, lifesaving, navigational equipment and crew protection. Insurance companies are encouraged to utilize these standards as they deem appropriate.

4. Recommendation 4: It is recommended that a copy of this report be forwarded to IMO.

Action: This recommendation is concurred with. A copy of this report will be forwarded to the Maritime Safety Committee of IMO.

5. Recommendation 5: It is recommended that this case be closed.

Action: This recommendation is concurred with.

J. S. GRACEY
Admiral, U.S. Coast Guard
Commandant

PART II

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United States Coast Guard

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16732/AMERICUS-ALTAIR
8 April 1985

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

Subj: F.V. AMERICUS/ALTAIR; FORWARDING OF REPORT OF INVESTIGATION

Ref: (a) COMDT (G-MMI-1/14) ltr 16732/AMERICUS of 28 Feb 83
(b) MSM 72-3
(c) 46 CFR 4.09-20

1. The subject report has been completed and is hereby forwarded. Transcripts, exhibits, and the administrative letter file will be forwarded under separate correspondence. Copies of of the report have been forwarded to CCGD13(d) and COMPACAREA as per reference (a).

J. E. DECARTERET
Captain, U.S. Coast Guard
Chairman

Encl: (1) Report of Investigation (original + 3 copies, w/o encl)

U.S. Department of Transportation
United States Coast Guard

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Thirteenth Coast Guard District

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16732/AMERICUS-ALTAIR
8 April 1985

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

Subj: F.V. AMERICUS, O.N. 595 758, capsizing and sinking - F.V. ALTAIR, O.N. 618 390, disappearance on or about 14 February 1983 in the Bering Sea, north of Dutch Harbor, Alaska, with presumed multiple loss of life

FINDINGS OF FACT

1. On 14 February 1983 at approximately 0230 (all times Bering Standard Time - GMT +11) the fishing vessel ALTAIR departed Dutch Harbor, AK enroute to crab fishing grounds in the vicinity of the Pribilof Islands. The fishing vessel AMERICUS began an identical voyage six hours later. At 1510 that afternoon a capsized hull was sighted by the M.V. NEPTUNE JADE approximately 25 miles NNW of Dutch Harbor, and reported to the Coast Guard Communications Station in Kodiak, AK. Early in the morning of 15 February a diving rescue party departed on the fishing vessel GOLDEN PISCES from Dutch Harbor and, upon arrival on scene, identified the capsized vessel as the AMERICUS. An extensive search effort was undertaken for possible survivors from the AMERICUS, and numerous unsuccessful efforts to contact the ALTAIR by radio were attempted. The AMERICUS sank in over 4000 feet of water on 16 February. No survivors or victims were ever sighted. The search for the ALTAIR continued until 20 February, but was suspended with negative results. An unoccupied inflatable liferaft from the ALTAIR, found on 16 March 1983 within eleven miles from where the AMERICUS hull was first observed capsized, is the only sighting from the ALTAIR. The seven-man crews from each vessel remain missing.

2. VESSEL DATA:

NAME:	AMERICUS	ALTAIR
OFFICIAL NO.:	595 758	618 390
SERVICE:	fishing	fishing
GROSS TONS:	194	190
NET TONS:	131	129
OVERALL LENGTH:	123.5'	123.5'
REG. LENGTH:	111.5'	111.5'
REG. BREADTH:	32.0'	32.0'
REG. DEPTH:	10.7'	10.7'
PROPULSION:	diesel	diesel
HORSEPOWER:	1125	1125
HOME PORT:	Port Angeles, WA	Port Angeles, WA
YEAR BUILT:	1978	1980
MANAGING OWNER:	Jeff Hendricks & Assoc. 2804 Oakes Ave. Anacortes, WA 98221	Jeff Hendricks & Assoc. 2804 Oakes Ave. Anacortes, WA 98221
MASTER:	George C. Nations	Ronald C. Biernes
LICENSE:	none	none
VALUE OF VESSEL:	$3,000,000	$3,200,000

The AMERICUS and ALTAIR were two of seven sister vessels built by Dakota Creek Industries, Inc., 115 "Q" Ave, P.O. Box 218, Anacortes, WA 98221. They were typical crab fishing vessels of hard chine construction, with raised forecastles forward housing the galley, reefer spaces, and crew quarters. The bridge is located on top of the forecastles. There are large open deck spaces aft (See Figure 1). Four crab tanks are located below deck aft. The engine rooms are located forward of the crab tanks, below the forecastles. Fuel storage is in settling tanks forward, wing tanks and double bottom tanks adjacent to the crab tanks, and deep tanks aft. There are dry cargo stowage areas in the lazarette and between the crab tanks and deep tanks.

The vessels were designed by Mr. Jacob Fisker-Andersen, 6224 102nd Place NE, Kirkland, WA 98033. The first of the class, the ANTARES, was inclined, and the original lightship displacement of 289.3 tons was calculated. The stability booklet prepared for the ANTARES followed the International Maritime Organization (IMO) guidelines for fishing vessel stability published in Coast Guard Navigation and Vessel Inspection Circular (NVC) 3-76. These guidelines have not been officially adopted by the U.S. Government (since fishing vessels remain unregulated) but were used by Mr. Fisker-Andersen since they are "recommended by the Coast Guard". Stability booklets for each of the other vessels of this class (except one, noted later) were based on the ANTARES inclining. (Note: ALTAIR's lightship displacement was originally calculated to be 296.9 tons. This takes into account crab tank insulation, which is essentially the only difference between the AMERICUS and ALTAIR. The ALTAIR was not inclined.) Deadweight surveys to verify lightship displacement were not performed on any of the later vessels.

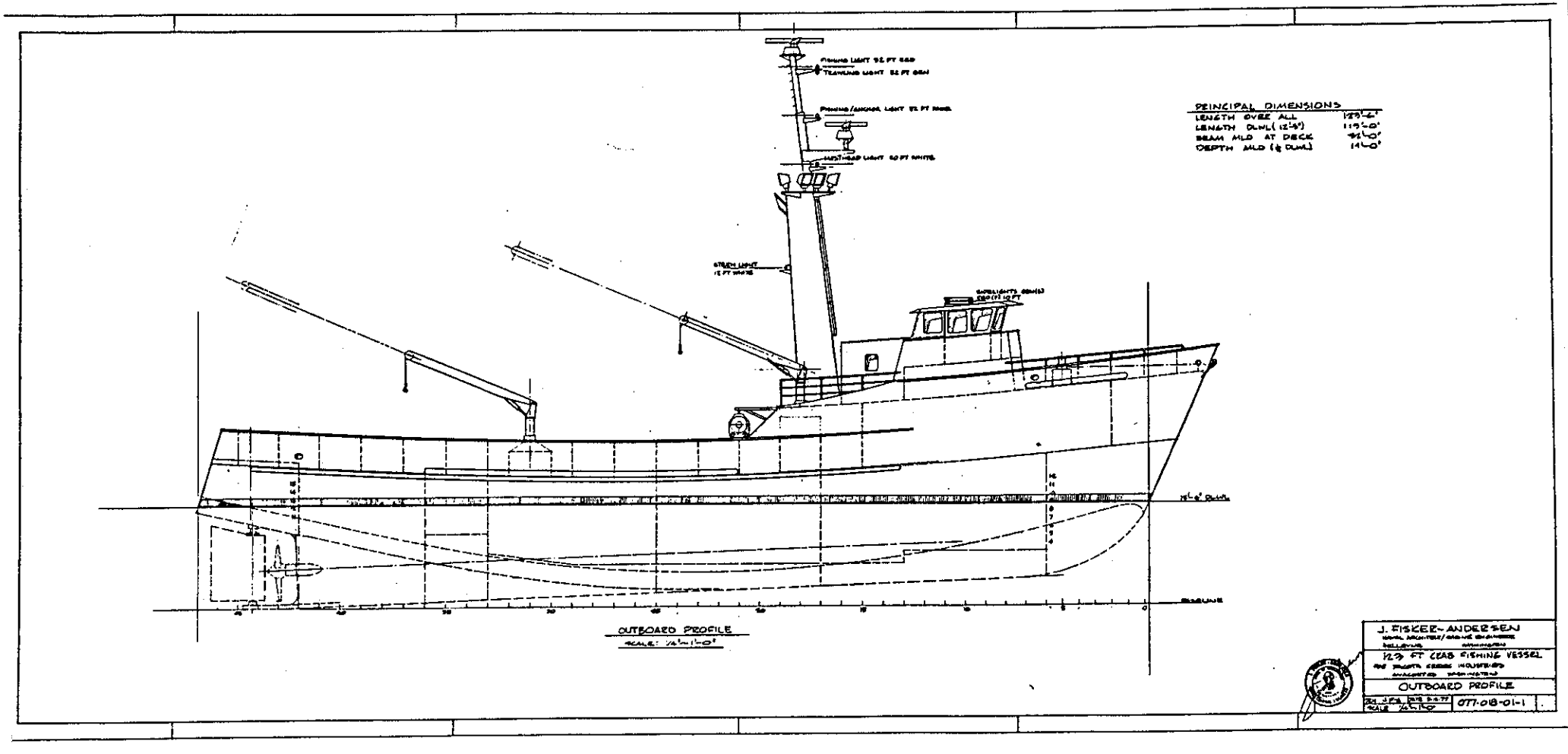
The decline in the crab fishery during the past few years has led many crab boat owners to retrofit trawling gear to enable harvesting other resources of the sea. The AMERICUS and ALTAIR underwent three such conversions (February 1981, December 1981, and January 1983). The total drag gear conversion weight for each vessel is estimated at 78,905 pounds - 35.2 tons. The stability booklets on the AMERICUS and ALTAIR at the times of their losses were the original ones, provided when the vessels were new, and had not been updated.

The AMERICUS and ALTAIR were not subject to inspection, manning, or loadline requirements. Rules and regulations governing uninspected vessels (Subchapter C - 46 CFR 24-26) are the only domestic shipping standards which apply.

Mr. Jim J. Goldade, an independent marine surveyor, had occasion to examine each vessel upon delivery, and again in late 1981 (AMERICUS 25 November 1981, ALTAIR 9 December 1981). During his 1981 inspections he found the vessels were being outfitted with trawl systems and noted this in his reports. He also checked for stability letters, but did not examine them to ensure they were up to date. He stated, during testimony before the Board, that that responsibility rested with the naval architect.

The AMERICUS and ALTAIR were boarded by Coast Guard Marine Safety Office personnel from Anchorage, AK in April 1981, prior to being chartered by National Marine Fisheries. That examination was limited to inspection of the vessels' lifesaving and related safety equipment. Each vessel had an Emergency Position Indicating Radio Beacon (E.P.I.R.B) and ten survival suits. These items were customarily kept in settees in the pilothouses.

FIGURE 1



(Does not include drag gear)

3. RECORD OF PRESUMED DEAD:

AMERICUS

NAME:	George C. Nations	Brent Boles
ADDRESS:	2702 Oakes Ave. Anacortes, WA 98221	4010 "R" Ave. Anacortes, WA 98221
AGE:	43	24
DATE OF BIRTH:	21 December 1941	8 March 1958
POSITION ON VESSEL:	Master (Captain)	Relief Captain
CG LIC./MMD:	none	none
EXP. IN FISH INDUS:	13 yrs 2-1/2 mos	4 yrs 10-1/2 mos
NEXT OF KIN:	wife - Janice Nations	father - George Boles

NAME:	Larry Littlefield	Paul Northcutt
ADDRESS:	1390 So. Green St. Anacortes, WA 98221	3805 "Q" Ave. Anacortes, WA 98221
AGE:	29	24
DATE OF BIRTH:	15 January 1954	11 May 1958
POSITION ON VESSEL:	Engineer	Cook/Deckhand
CG LIC./MMD:	none	none
EXP. IN FISH INDUS:	9 yrs 2-1/2 mos	4 yrs 1-1/2 mos
NEXT OF KIN:	father - Al Littlefield	mother - Eve Northcutt

NAME:	Jeff Nations	Victor Bass
ADDRESS:	2702 Oakes Ave. Anacortes, WA 98221	1519 "K" Ave. Anacortes, WA 98221
AGE:	19	19
DATE OF BIRTH:	26 November 1963	31 August 1963
POSITION ON VESSEL:	Deckhand	Deckhand
CG LIC./MMD:	none	none
EXP. IN FISH INDUS:	167 days	first voyage
NEXT OF KIN:	mother - Janice Nations	parents - Lloyd & Jean Bass

NAME:	Rich Awes
ADDRESS:	1019 "D" Ave. Anacortes, WA 98221
AGE:	20
DATE OF BIRTH:	23 July 1962
POSITION ON VESSEL:	Deckhand
CG LIC./MMD:	none
EXP. IN FISH INDUS:	first voyage
NEXT OF KIN:	parents - Elden & Lois Awes

ALTAIR

NAME:	Ronald Biernes	Jeff Martin
ADDRESS:	1168-C Laura Jo Lane Anacortes, WA 98221	1811 9th Anacortes, WA 98221
AGE:	47	23
DATE OF BIRTH:	10 July 1935	27 May 1959
POSITION ON VESSEL:	Master (Captain)	Engineer
CG LIC./MMD:	none	none
EXP. IN FISH INDUS:	24 yrs	2 yrs
NEXT OF KIN:	wife - Nancy Biernes	father - Don & Roberta Martin

NAME:	Tony Vienhage	Lark Breckenridge
ADDRESS:	2220 31st Anacortes, WA 98221	1113 7th Anacortes, WA 98221
AGE:	27	24
DATE OF BIRTH:	7 November 1955	27 August 1958
POSITION ON VESSEL:	Cook/Deckhand	Deckhand
CG LIC./MMD:	none	none
EXP. IN FISH INDUS:	3 yrs	5 mos
NEXT OF KIN:	wife - Mary Vienhage	wife - Kelly Breckenridge

NAME:	Brad Melvin	Troy Gudbranson
ADDRESS:	706 38th Anacortes, WA 98221	802 24th St., Apt. C Anacortes, WA 98221
AGE:	26	21
DATE OF BIRTH:	18 March 1956	10 October 1961
POSITION ON VESSEL:	Deckhand	Deckhand
CG LIC./MMD:	none	none
EXP. IN FISH INDUS:	3 yrs 2-1/2 mos	4 yrs
NEXT OF KIN:	father - Wayne Melvin	wife - Jody Gudbranson

NAME:	Randy Harvey
ADDRESS:	4713 Yorkshire Anacortes, WA 98221
AGE:	23
DATE OF BIRTH:	23 May 1959
POSITION ON VESSEL:	Deckhand
CG LIC./MMD:	none
EXP. IN FISH INDUS:	first voyage
NEXT OF KIN:	parents - Richard & Margurite Harvey

4. WEATHER DATA:

Environmental conditions in the Bering Sea were very moderate on 14 February 1983. Visibility was up to seven miles except when reduced to 1/2 to 1-1/4 miles in occasional light snow showers. Air temperatures remained in a narrow range around the freezing mark. Sea water temperature was about three degrees Centigrade. At 0100 on 14 February seas ranged from one to two feet. Throughout the period seas, east northeasterly, were off the stbd beams of AMERICUS and ALTAIR. Winds, from the same direction, ranged from two to nine knots between 0100 - 0400. By 1500 that day winds had increased to an average of 14-18 knots, and seas had increased to six to eight feet. By 0800 15 February seas had heightened to 12-14 feet, and winds were blowing at 35-50 knots. There were no reported problems with icing.

5. The AMERICUS and ALTAIR both underwent the final phase of their drag gear conversions at Dakota Creek Industries, Inc. in January 1983. They both departed Anacortes, WA fully fueled (less amounts consumed during sea trials of an estimated 24 hours duration) and provisioned on 3 February, proceeding non-stop to Dutch Harbor over the course of the next seven days. It was estimated each vessel consumed approximately 10,000 gallons of fuel on this trip. The vessels customarily proceeded at full speed, which is about 10 knots.

6. On 10 February the AMERICUS attempted transferring diesel fuel to the fish processing vessel SEA ALASKA, located at the Sea Alaska Terminal in Dutch Harbor. This practice was common among Jeff Hendricks & Assoc. vessels to take advantage of the fuel price differential (then $.159/gallon) between Anacortes and Dutch Harbor. A pump problem, subsequently corrected, prevented the transfer on this date. SEA ALASKA records show the following fuel transfers from Jeff Hendricks & Assoc. vessels took place:

11 February 1984	AMERICUS	28,000 gallons
12 February 1984	ALTAIR	27,730 gallons
13 February 1984	ALYESKA	38,915 gallons

The tanks from which fuel on the AMERICUS and ALTAIR was taken are unknown. The only witness evidence available is from Mr. Dean Brenengen, an engineer on the SEA ALASKA, who said "...he (the AMERICUS engineer) said something about (starting from) a front tank with 8,000 or 10,000 gallons."

7. On 11 February 1983 the AMERICUS received 280 cases of frozen herring (for baiting crab pots). The ALTAIR received 289 cases. The cases weighed 32-33 pounds each.

8. Crab pot loading took place from 10-13 February. Each pot measured 7' x 7' x 32" and, with its associated gear, weighed about 690 pounds. Each vessel was loaded with six tiers of pots. The first tier was stacked vertically on the 32 inch edge. Tiers 2-6 were stacked flat. The AMERICUS received 228 pots, and the ALTAIR 224. The following gear from each vessel was removed before crab pots were loaded:

Forward net reel, with vertical stanchions	3,135 pounds
Capstan	300 pounds (est.)

9. There were four Jeff Hendricks & Assoc. fishing vessels in Dutch Harbor: AMERICUS, ALTAIR, ALYESKA, and ALLIANCE. All four conducted their business at the Sea Alaska Terminal. Each was engaged in or intending to engage in crab fishing in the vicinity of the Pribilof Islands. All had recently traveled from Anacortes to Dutch Harbor. The ALLIANCE, a 103-foot bow picker, was the first to arrive and, prior to 14 February, had made two trips with crab pots to the Pribilof Island area. The ALYESKA, identical to the AMERICUS and ALTAIR, with the exception of one foot less draft amidships, arrived in Dutch Harbor on 8 February. The ALYESKA made one crab pot run to the Pribilofs before her 13 February fuel transfer to the SEA ALASKA. The ALLIANCE and ALYESKA were both in Dutch Harbor prior to and at the times of the AMERICUS-ALTAIR departures on 14 February.

10. The AMERICUS and ALTAIR were visited by a number of personnel from the ALLIANCE and ALYESKA during the day prior to their sailings. There were no activities or observations which aroused suspicions. Everything appeared normal. Those crew members who visited the AMERICUS and ALTAIR were questioned extensively about how the vessels were loaded, and how they appeared. The most positive additional evidence on loading was received from Mr. Steve Carr, engineer from the ALYESKA. Mr. Carr was on board the AMERICUS on 13 February and learned from the AMERICUS engineer, Mr. Larry Littlefield, that the crab tanks were "cross-tanked." Cross tanking was defined as filling

two diagonally opposite crab tanks with water (i.e., 1P and 2S, or 1S and 2P), with the other two tanks kept empty. This was described as a measure intended to compensate for the lighter fuel load. Although evidence on the status of ALTAIR's crab tanks is less certain, Mr. Glen Treadwell, master of the ALLIANCE, raised the possibility that all four of ALTAIR's crab tanks were full. This recollection was not formed until one year and five months after the ALTAIR disappeared. (See Board Exhibit No. 177)

11. The ALTAIR's departure from Dutch Harbor at 0230 on 14 February was observed by Mr. Treadwell and Mr. John Babarovich, engineer on the ALLIANCE. The ALTAIR appeared normal in all respects to them. At about 0330 the F.V. SILVER WAVE, returning to Dutch Harbor from the Pribilofs, passed within about 150 yards of ALTAIR. The SILVER WAVE helmsman, Mr. Dagfin Halvorsen, saw ALTAIR's name, and said the vessel was proceeding on a course towards the Pribilof Islands at a speed of 10-11 knots. He characterized ALTAIR's appearance as "normal." The weather was clear, winds were slight, and seas were estimated at two feet. Mr. Halvorson's sighting, which he estimates to have been about 20 miles out of Dutch Harbor, is the last known time the ALTAIR was observed.

12. Mr. Babarovich observed the AMERICUS departure at 0830. He described the boot top stripe as visible forward, but at the water aft. The Sea Alaska foreman, Mr. Vern Helms, freed lines from the dock as the AMERICUS got underway. The stern line, at one point, was slack and extended just under the rubber bumpers for the drag doors. He described that as proximate to where the waterline was. Messrs. Babarovich and Helms felt the AMERICUS appeared normal in all respects.

13. At 1510, 14 February 1983, the M.V. NEPTUNE JADE observed the presence of a capsized hull, with a red boot top stripe, at Lat 54°19.6'N, Long 166°54'W. (Note: The AMERICUS boot top stripe was red; ALTAIR's was white.) The NEPTUNE JADE was unable to contact the Coast Guard Communications Station in Kodiak, AK to report the wreckage, but the message was successfully relayed by the M.V. ALEUTIAN DEVELOPER. NEPTUNE JADE personnel looked for possible survivors, but made no sightings and departed within 30 minutes. Attempts to alert a car carrier approximately ten miles astern were unanswered. At 1608 the M.V. OCEAN BROTHER, a car carrier, located a capsized hull at Lat 54°17'N, Long 166°58'W (position obtained by dead reckoning from a noon fix) and reported the observation by radio to the Coast Guard Communications Station in Honolulu, HI. The OCEAN BROTHER remained on scene within one-half mile of the capsized vessel for about thirty minutes, but did not locate any survivors or make any other sightings and departed. OCEAN BROTHER personnel did not report a boot top color. Both the NEPTUNE JADE and OCEAN BROTHER were destined for ports in the far east, sailing in the Pacific Rim great circle shipping lanes.

14. Coast Guard Air Station Kodiak dispatched a C-130 aircraft after evaluating reports on the capsized hull. Arriving on scene after dark, a search was conducted for flares, lights, and Electronic Locater Transmitter (ELT) signals. Results of this effort were negative.

15. Mr. Gary Howell, master of the F.V. ALASKA INVADER, overheard the ALEUTIAN DEVELOPER radio transmissions that afternoon reporting the capsized hull. The ALASKA INVADER, along with the F.V. PACIFIC INVADER, were then about 50 miles WSW of the NEPTUNE JADE. Both proceeded to the coordinates

given, arriving on scene between 1900-2000. Two Soviet fish processing vessels, BMRT SVETLAYA and BMRT TURKUL, also overheard radio traffic addressing the capsized hull. These vessels, engaged in a joint venture agreement with Marine Resources, Inc., were then about 30 miles north of Dutch Harbor. The TURKUL headed towards Dutch Harbor to rendezvous with the F.V. MUIRLACH and receive on board representatives from National Marine Fisheries and Marine Resources, Inc. The two processing vessels planned to respond to the reports of the wreckage and search for survivors. SVETLAYA arrived on scene at about 2030, followed by TURKUL at 2200. The ALASKA INVADER and PACIFIC INVADER departed for Dutch Harbor shortly afterwards, maintaining lookouts for survivors while enroute. None of the four vessels on scene had as of yet made any sightings.

16. Reports of the sighting of the capsized hull circulated through the Dutch Harbor area on the evening of 14 February. Mr. Treadwell and Mr. Brian Melvin, masters of the ALLIANCE and ALYESKA, learned of the capsized vessel when it was announced by radio during the 1800 weather forecast. The two were together at the time in the ALLIANCE pilothouse. There was no information about the identity of the wreck (other than being described as an 80-foot vessel), and neither gave any thought to it being the AMERICUS or ALTAIR. Rumors suggested the capsized vessel was a boat which had burned earlier in Akutan, AK. The ALLIANCE and ALYESKA got underway at approximately 2200, with crab pots enroute to the Pribilofs.

17. Mr. Loni R. Sullivan, Acting Chief of Police, Unalaska, AK was advised of the presence of a capsized vessel north of Dutch Harbor on the evening of 14 February. He called the Coast Guard Rescue Coordination Center in Juneau, AK for amplifying information, and after discussion agreed to organize a diving team for possible rescue operations. Mr. Sullivan approached Mr. Buster McNabb, owner/operator of the F.V. GOLDEN PISCES, to arrange for transportation. Mr. Bill Evans, a commercial diver then working out of Unalaska, AK, agreed to assist. Mr. Sullivan assembled four volunteer members of the Unalaska Dive Team and alerted Alaska State Trooper John Leonard, who also joined the contingent. Plans were made for an early morning departure in order to arrive on scene by daylight.

18. At about 0400, 15 February 1983, the SVETLAYA located the capsized hull. At 0430 the TURKUL found an unoccupied inflatable liferaft about one mile downwind from the wreck, and took it on board. The GOLDEN PISCES arrived on scene (Lat 54°17'N, Long 167°22'W) at about 0800. The SVETLAYA and TURKUL were then still in the area searching. While viewing the capsized hull, Mr. McNabb recognized the rubber bumpers for the drag doors and the hull color as characteristic of vessels owned by Jeff Hendricks & Assoc. After circling the wreck for a while, a large wave raised the bow out of the water. Mr. McNabb recognized the AMERICUS bow emblem (an American flag). The identity of the wreck, heretofore unknown, was confirmed shortly afterwards when crab pot floats with the AMERICUS Alaska Department of Fish and Game number (33598) were sighted. Mr. McNabb called the Sea Alaska Terminal to report his observations and recommend that Jeff Hendricks be notified. The ALYESKA, then nearly halfway to the Pribilofs, overheard Mr. McNabb's report to Sea Alaska. Mr. Melvin called the GOLDEN PISCES for further information. He then contacted Mr. Treadwell on the ALLIANCE. Efforts to raise the ALTAIR by radio were unsuccessful. The ALYESKA and ALLIANCE diverted to shallow water to jettison crab pots (to make deck space available for possible rescue operations), then backtracked to the AMERICUS.

19. Seas, previously calm, had risen to an estimated 12-15 feet by the morning of 15 February. The AMERICUS hull was often awash, and the GOLDEN PISCES was rolling heavily. Mr. Sullivan opted not to risk the hazards of placing divers in the water after Mr. McNabb raised questions about his ability to retrieve them safely. The GOLDEN PISCES, SVETLAYA, and TURKUL continued searching in the area. GOLDEN PISCES crossed back to the AMERICUS hourly to monitor drift of the vessel. Gradual settling was observed. C-130 aircraft from Coast Guard Air Station Kodiak conducted a search throughout the day. The Coast Guard Cutter SHERMAN was designated On Scene Commander (OSC) and was proceeding to scene. The TURKUL and SVETLAYA, after searching for 17 hours without results, discontinued their efforts that afternoon. At 1700, with no sightings made and darkness setting in, the GOLDEN PISCES returned to Dutch Harbor.

20. The ALYESKA located the AMERICUS at 2345, at Lat 54°16.5'N, Long 167°34.5'W. The ALLIANCE arrived at 0236, 16 February, and remained in sight of the AMERICUS while the ALYESKA continued to search for survivors. CGC SHERMAN arrived on scene at approximately 0630. An HH-52 (NR 1425) from the SHERMAN was launched at daylight to search the north side of Umnak and Unalaska Islands. Two C-130's (NR 1603 and NR 1500) and an H-3 (NR 1488) also joined in the search. At 1130 the ALLIANCE witnessed sinking of the AMERICUS at Lat 54°24.5'N, Long 168°21.8'W. The water is 700 fathoms deep in this area. Approximately seven minutes later two ring buoys and one inflatable liferaft popped to the surface and were recovered by the ALLIANCE. Subsequent examination of records confirmed the liferafts recovered by the TURKUL and ALLIANCE came from the AMERICUS.

21. The AMERICUS-ALTAIR search expanded and continued. In addition to Coast Guard resources, long range aircraft from Elmendorf Air Force Base, Anchorage, AK, and the Naval Station at Adak, AK participated. Altogether 26,000 square miles were covered, but no sightings were made and the active search was suspended on 20 February. Jeff Hendricks & Assoc. chartered a private aircraft to continue the land search, but the results were negative.

22. On 16 March 1983 an inflatable liferaft from the ALTAIR was found by the ALLIANCE at Lat 54°24'N, Long 166°53'W. This location is approximately eleven miles from where the NEPTUNE JADE initially observed the AMERICUS hull on 14 February, and approximately 37 miles out of Dutch Harbor. The ALLIANCE was traveling between Dutch Harbor and the Pribilofs. The liferaft was torn and only partially inflated. Its provisions were missing, and one end was covered with green marine growth. There was no evidence to suggest the raft had ever been occupied. This was and remains the only sighting from the ALTAIR.

STABILITY INVESTIGATION

23. The AMERICUS hull was sighted floating keel up by personnel on several different vessels. No damage to the hull was observed. Likewise, there were no known problems or suspicions about the materiel condition of the AMERICUS and ALTAIR, and there was no evidence suggesting hull or equipment failure produced or contributed to these casualties. Having gathered facts during the first month after the loss of the AMERICUS and disappearance of the ALTAIR, the Board moved towards investigating a capsizing scenario. Prof. Bruce Adee, Director, Ocean Engineering Program, University of Washington, Seattle, WA was retained by the Board as a consultant. A Stability Work Statement defining

how the AMERICUS and ALTAIR were loaded (as best as could be determined) and the analyses to be performed was prepared. Where particulars of loading were unknown, assumptions by the managing owner, Jeff Hendricks, based on his familiarity with operations of the vessels, were made. Alternate conditions (i.e., fuel distribution and crab tank loading) were also explored in order to investigate other possibilities and provide a basis from which deductions might be drawn.

24. FUEL LOADING:

The diesel fuel capacities of the AMERICUS (See Figure 2 - Tankplan) and ALTAIR differ slightly, due to ALTAIR's crab tank insulation, and are listed in gallons as follows:

		AMERICUS 100%	95%	ALTAIR 100%	95%
No. 1 Double Bottom	P	4,020	3,819	3,477	3,303
" " " "	S	4,020	3,819	3,477	3,303
No. 2 Double Bottom	P	3,680	3,496	3,137	2,980
" " " "	S	3,680	3,496	3,137	2,980
No. 2 Wing Tank	P	5,091	4,836	5,091	4,836
" " " "	S	5,091	4,836	5,091	4,836
No. 3 Wing Tank	P	4,865	4,622	4,865	4,622
" " " "	S	4,865	4,622	4,865	4,622
No. 4 Wing Tank	P	9,234	8,772	9,324	8,722
" " " "	S	9,234	8,772	9,234	8,722
Deep Tank Centerline		14,578	13,849	14,578	13,849
F.O. Settling Tank		5,588	5,309	5,588	5,309
	TOTAL	73,946	70,248	71,744	68,084

Fuel distribution on each vessel upon departure from Dutch Harbor was estimated by Jeff Hendricks as follows:

Tank		Status
No. 1 Double Bottom	P	Full
" " " "	S	Full
No. 2 Double Bottom	P	Full
" " " "	S	Full
No. 2 Wing Tank	P	Empty
" " " "	S	Empty
No. 3 Wing Tank	P	Empty
" " " "	S	Empty
No. 4 Wing Tank	P	Empty
" " " "	S	Empty
Deep Tank Centerline		Full
F.O. Settling Tank		Full

These estimates are based on the belief that the vessels, proceeding from Anacortes to Dutch Harbor, would have drawn from and essentially emptied the No. 2 Port and Stbd Wing Tanks, and then transferred fuel to the SEA ALASKA from the Nos. 3 and 4 Port and Stbd Wing Tanks. The stability booklets for the AMERICUS and ALTAIR specifically direct maintaining fuel in the double bottoms for ballast while carrying the crab pot loads known to have been on

board. The ALYESKA stability booklet (also prepared by Mr. Fisker-Andersen) contained the same instruction. However, ALYESKA'S double bottoms were emptied during her 13 February transfer of fuel to the SEA ALASKA. This led to consideration that the AMERICUS and ALTAIR may also have had empty double bottoms.

In a Board session subsequent to preparation of the Stability Work Statement, Mr. Hendricks testified to having known of instances, during transfers of fuel from the AMERICUS and ALTAIR to the SEA ALASKA previous to February 1983, when Captains Nations and Biernes emptied double bottom tanks.

25. CRAB TANK FLOODING:

The testimony of the ALYESKA engineer provided evidence that the AMERICUS sailed from Dutch Harbor with the crab tanks cross-tanked. This would have added approximately 130 tons to the vessel's load. The AMERICUS-ALTAIR stability booklets specified empty crab tanks given the number of crab pots carried. During preparation of the Stability Work Statement (before 18 April 1983) there was no indication of the status of ALTAIR's crab tanks. It was known, however, that the ALYESKA sailed on 14 February 1983 with all four crab tanks flooded, giving rise to the possibility that ALTAIR may have done the same. ALYESKA's stability booklet, like that for the AMERICUS and ALTAIR, did not provide for crab tank flooding given the load of crab pots (171 on ALYESKA) then being carried.

26. DRAG GEAR CONVERSIONS:

The AMERICUS and ALTAIR were outfitted with trawling gear and modified as follows (list omits gear removed in Dutch Harbor):

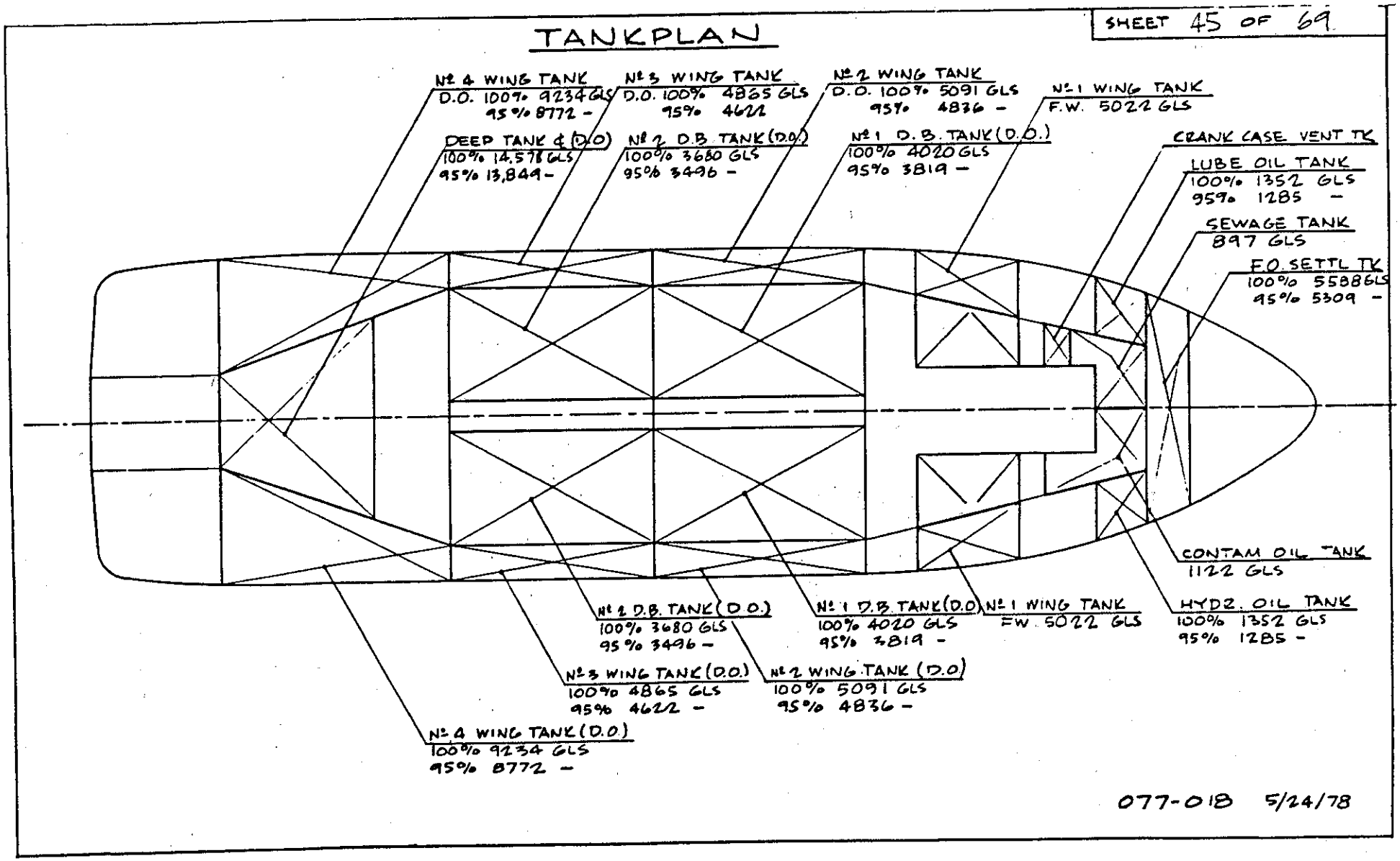
First Conversion (February 1981)

	Weight (pounds)	Total
MAIN DECK, BULWARKS		
Drag stanchions	7,730	
Net reel	3,135	
Stern ramp	1,075	11,940 (5.33 tons)

Second Conversion (December 1981)

	Weight (pounds)	Total
BOTTOM OF HULL		
Sonar tank	176	
Dome and lifting gear	637	
Transducer and housing	300	1,113
ENGINE ROOM		
Marco gear box and clutch	600	
Hydraulic pumps	670	
Electronic cabinets	210	
Electric motors	985	
Relief valves	130	
Filters	200	
Miscellaneous	135	
Piping	2,000	4,930

FIGURE 2


TANKPLAN
SHEET 45 OF 69
Nº 4 WING TANK
D.O. 100% 9234 GLS
95% 8772 –
Nº 3 WING TANK
D.O. 100% 4865 GLS
95% 4622
Nº 2 WING TANK
D.O. 100% 5091 GLS
95% 4836 –
Nº 1 WING TANK
F.W. 5022 GLS
DEEP TANK & (D.O)
100% 14,578 GLS
95% 13,849 –
Nº 2 D.B TANK (D.O.)
100% 3680 GLS
95% 3496 –
Nº 1 D.B. TANK (D.O.)
100% 4020 GLS
95% 3819 –
CRANK CASE VENT TK
LUBE OIL TANK
100% 1352 GLS
95% 1285 –
SEWAGE TANK
897 GLS
F.O. SETTL TK
100% 5588GLS
95% 5309 –
CONTAM OIL TANK
1122 GLS
HYDR. OIL TANK
100% 1352 GLS
95% 1285 –
Nº 1 WING TANK
FW 5022 GLS
Nº 1 D.B. TANK (D.O)
100% 4020 GLS
95% 3819 –
Nº 2 D.B. TANK (D.O.)
100% 3680 GLS
95% 3496 –
Nº 2 WING TANK (D.O)
100% 5091 GLS
95% 4836 –
Nº 3 WING TANK (D.O.)
100% 4865 GLS
95% 4622 –
Nº 4 WING TANK (D.O)
100% 9234 GLS
95% 8772 –
077-018 5/24/78

MAIN DECK, BULWARKS			
Cable winch (3rd wire)	1,200		
Hydraulic control valves	500		
Foundations	1,570		
Stern ramp roller	350	3,620	
01 DECK			
Rapp winches	22,000		
1" cable-1200 fathoms	13,200	35,200	
PLENUM			
Hydraulic valve panels	410		
Electrical power supply	200	610	
PILOTHOUSE			
Simrad electronics package	200		
Furuno electronics	200	400	
MAST			
Mast sheaves	682		
Two (2) M-25 pulmaster winches @ 1070# each	2,140		
Cable for winches	397	3,219	
		49,092	(21.92 tons)

Third Conversion (January 1983)

MAIN DECK, BULWARKS	Weight (pounds)	Total	
Gantry	2,500		
Diamond deck plate	7,573		
Wood deck grating (removed)	(2,500)		
Rubber bumpers, bulwark stern	10,000		
Tow pin	300	17,873	(7.98 tons)

Total Drag Gear Conversion Weight: 78,905 (35.2 tons)

As stated previously, the AMERICUS and ALTAIR stability booklets were not updated for any of these conversions. The ALYESKA had undergone identical conversions, and after her first Mr. Fisker-Andersen was asked to make some stability calculations. He was informed the conversion weight was approximately 12.2 tons. Calculations on paper, without the benefit of an inclining experiment or deadweight survey, yielded a new maximum crab pot carrying capacity of 228, down from 258. Since the AMERICUS and ALTAIR were originally rated for carrying a maximum 258 pots, it was considered unnecessary by the owner and designer to refigure their stability booklets. The owner opined further that the reduced crab pot carrying capacity, due to loss of deck space through the addition of trawl gear, offset the added weight and thus amounted to a trade-off. Mr. Fisker-Andersen was not requested to make calculations taking into account what effect the second and third conversions might have had until after the vessel losses occurred. It is noted that the estimated weight added to the ALYESKA during her first conversion is not in agreement with the first conversion weights listed above. The AMERICUS and ALTAIR conversion weights were provided by Dakota Creek Industries.

27. OTHER TANKAGE:

The No. 1 Port and Stbd wing tanks, used for fresh water, hold 5,022 gallons each when 100% full (total capacity 10,044 gallons each vessel). The AMERICUS and ALTAIR were estimated to have been carrying 35% of their water capacity upon departure from Dutch Harbor. The vessels customarily carried this amount to limit trimming by the bow.

The lube oil and hydraulic oil tanks hold 1,352 gallons at 100% volume and 1,285 gallons at 95%. These tanks were filled in early February before the vessels departed Anacortes. Product from the lube oil tanks may have been drawn for servicing prior to departure from Anacortes, and for replenishment during the voyage to Dutch Harbor. For the purposes of this stability investigation, these tanks are assumed to have been full. The contaminated oil tanks hold 1,122 gallons at 100% volume and 1,066 gallons at 95%. The sewage tanks hold 897 gallons when full. No estimates are available for the amounts in these tanks when the vessels departed Dutch Harbor. For the purposes of this stability investigation these tanks are assumed to have been empty.

28. The net weight of crew provisions and personnel effects was estimated to be 2.0 tons. The weight of ships stores was estimated to be 2.0 tons. Refrigerated stores were estimated to weigh 5.0 tons. These are assumed amounts and were used by Mr. Fisker-Andersen in his original stability computations.

29. The initial focus of the Board was to investigate the effects of the drag gear conversions and varied fuel and crab tank loading scenarios. The AMERICUS was studied since information on her loading was better than ALTAIR's, and there were eye witness accounts as to the waterline location upon her departure from Dutch Harbor. The Stability Work Statement prepared by the Board specified tasks defining the analyses to be performed. Some tasks involved evaluating various loading conditions and calculating stability characteristics. The results were then to be compared with the IMO criteria for Fishing Vessel Stability. The original lightship displacement figure (289.3 tons) was used. The ANTARES suffered an extensive fire in March 1982, and in December 1982 was lost at sea while being towed to Seattle. During Phase One of the stability investigation none of the remaining sister vessels were available for examination.

PHASE 1 (18 April 1983 - 23 June 1983)

30. Preparations for the stability investigation involved examination of the Stability Work Statement with its attending references and plans of the vessels, and the setting up of a computer program (Ship All-Characteristics Program) for statical stability evaluation. Where needs were identified, the Stability Work Statement was modified in order to utilize the best information available and obtain the best results possible. The original stability booklet for the AMERICUS was examined. No errors or omissions were noted. New lightship parameters for the AMERICUS, utilizing the original stability booklet and the drag gear conversion estimates, yielded the following comparison:

	AMERICUS (original)	AMERICUS (revised)
Lightship displacement (tons)	289.3	324.46
VCG (feet)	14.78	15.80
LCG (feet)	49.98	51.79

31. Task 120 of the Stability Work Statement called for estimating the displacement, longitudinal center of gravity (LCG), vertical center of gravity (VCG), draft, and trim of the AMERICUS on 14 February 1983, utilizing facts and assumptions of loading as follows:

a. Crab tanks cross-tanked.
b. Fuel distribution as estimated by Jeff Hendricks (except settling tank slack at 85%, rather than full).
c. Contaminated oil tank and sewage tank empty.
d. Lube oil tank and hydraulic oil tank full.
e. Fresh water tanks 35% full.
f. Refrigerated stores 5 tons.
g. Crew, provisions, and stores 2 tons.
h. Ships stores 2 tons.
i. Crab pots six tiers. First tier 88, tiers 2-6 @ 28 each. Total 228 pots @ 700# each.

This was believed to represent the best evidence on how AMERICUS was loaded.

32. Tasks 121 - 126 were variations of Task 120 as follows:

a. Task 121: Estimate loading of the AMERICUS as in Task 120, but substitute all crab tanks empty in lieu of crab tanks cross-tanked.

b. Task 122: Estimate loading of the AMERICUS as in Task 120, but substitute all crab tanks full in lieu of crab tanks cross-tanked.

c. Task 123: Estimate loading of the AMERICUS as in Task 120, but assume cross-tanked crab tanks are 75% full (free surface correction).

d. Task 124: Estimate loading of the AMERICUS as in task 120, but substitute the following fuel distribution:

Double Bottom Tanks (4)	Empty
Deep Tank Centerline	Empty
Nos. 2,3, & 4 Wing Tanks P & S	Full
Fuel Oil Settling Tank	85%

e. Task 125: Estimate loading of the AMERICUS as in Task 120, but substitute the following fuel distribution:

Double Bottom Tanks (4)	Empty
No. 4 Wing Tanks P & S	Empty
Nos. 2 & 3 Wings Tanks P & S	Full
Deep Tank Centerline	Full
Fuel Oil Settling Tank	85%

f. Task 126: Estimate loading of the AMERICUS as in Task 120, but assume the forward two crab tanks are empty and the aft two are full.

33. Task 127 specifies the loading of the AMERICUS as in Task 120, but assumes a lightship condition without the drag gear conversions. The purpose for this task was to evaluate what impact modifications to the vessel had on the stability characteristics.

34. Analysis of the loading conditions in Tasks 120-127 yielded the following:

				Draft (above baseline)*			
Task	Displacement	VCG	LCG	Fwd.	Aft	Mean	Trim
120	668.60 tons	14.67'	57.39'	12.54'	13.68'	13.11'	1.14'
121	539.47 tons	15.58'	56.82'	11.13'	12.11'	11.62'	0.98'
122	797.73 tons	14.05'	57.78'	14.40'	14.70'	14.55'	0.29'
123	636.32 tons	14.67'	57.27'	12.40'	13.08'	12.74'	0.68'
124	695.79 tons	15.01'	58.03'	12.88'	13.92'	13.40'	1.05'
125	683.20 tons	15.01'	57.48'	12.99'	13.55'	13.27'	0.57'
126	666.05 tons	14.71'	59.32'	11.76'	14.26'	13.01'	2.50'
127	633.40 tons	14.14'	56.88'	12.55'	12.89'	12.72'	0.33'

* All of Prof. Adee's draft readings are from the forward and aft perpendiculars. The forward perpendicular is six inches forward of frame zero, and 12 ft. forward of the forward draft marks. The aft perpendicular is 115 ft. aft of the forward perpendicular, and 12 ft. aft of the aft draft marks.

35. Evaluation of the stability of the AMERICUS under the loading conditions specified in Tasks 120 - 127 included calculating the initial metacentric height (GM) for each loading condition, and the drawing of the righting lever (GZ) curves, using the constant trimming moment method with sufficient heel angles to accurately determine the area under the GZ curves and the angle of maximum GZ. The evaluation also included comparing the area under the GZ curve, the angle of maximum heel, and the initial GM with the recommended stability criteria of paragraph 5.1(a) through 5.1(d) of the IMO Resolution on Fishing Vessel Stability.

The recommended criteria are as follows:

5.1(a) The area under the righting lever curve (GZ curve) should not be less than 10.339 ft.-degrees (.055 metre-radians) up to an angle of heel of 30°, not less than 5.639 ft.-degrees (.03 metre-radians) between the angles of heel of 30° and 40°, or the angle of flooding if this angle is less than 40°, and not less than 16.918 ft.-degrees (.09 metre-radians) from 0° to 40°, or the angle of flooding if this angle is less than 40°.

5.1(b) The righting arm lever (GZ) should be at least 0.656 ft. (.02 metres) at an angle of heel equal to or greater than 30°.

5.1(c) The maximum righting arm should occur at an angle of heel preferably exceeding 30°, but not less than 25°.

5.1(d) The initial metacentric height (GM) should not be less than 1.148 ft. (.35 metres).

The following table contains the area under righting lever, righting arm, heel at maximum righting arm, and initial GM of the AMERICUS under the specified loading conditions and compares these to the IMO recommendations. (Note: "*" indicates failure to meet the criterion):

	Area Under Righting Lever			Rt. Arm	Heel at Max.	Init
Task	0-30°	30-40°	0-40°	@ 30°	Rt. Arm°	GM
120	21.202	8.439	29.641	.911	21.75*	4.06'
121	23.175	10.002	33.177	1.177	25	3.12'
122	13.687	3.908*	17.575	.430*	15*	3.91'
123	22.295	9.138	31.433	1.005	23.75*	3.74'
124	16.428	4.418*	20.846	.534*	15-20*	3.22'
125	17.347	5.598*	22.945	.650*	15-20*	3.50'
126	19.310	6.019	25.329	.720	20*	3.98'
127	28.105	13.961	41.796	1.401	30	4.45'

The results of this evaluation are plotted in Figure 3. The dotted lines in Figure 3 represent the required initial GM and a hypothetical GZ curve mathematically constructed to illustrate the minimum IMO criteria (See Appendix A). It is recognized the slope of the curve is not representative of an actual vessel. The purpose of this curve is to offer a visual comparison of how the various loading conditions meet, exceed, or fail to meet the criteria.

36. Task 130 called for an estimate of the trim and displacement of the AMERICUS upon her departure from Dutch Harbor, based on observations of the Sea Alaska foreman and the ALLIANCE engineer. Estimates were made with regard to the proximity of the boot top stripe to the waterline. The location of the top of the boot top stripe (taken off the Outboard Profile drawing) was assumed to be at the bottom of the 10 foot draft mark forward, and at the top of the 13 foot draft mark aft. The following estimates were made:

Draft aft - approx. 13.55 feet above the base line.
Draft fwd - less than 13.5 feet above the base line.

On the basis of this analysis, the following possible load conditions were eliminated:

Task 121 - draft is not enough.
Task 122 - draft is too much.
Task 123 - stern draft is too much.

The load conditions defined in Tasks 120, 124 and 125 were consistent with accounts of the AMERICUS' departure.

37. ANALYSIS:

The results of the initial stability analysis did not reveal any clear answers explaining the losses of the AMERICUS and ALTAIR. Prof. Adee commented that "from a design point of view, they're (the vessels) excellent." Assuming identical loading of the crab tanks and fuel distribution, the minor differences in loading (number of crab pots, cases of bait, amounts of fuel) and insulation of ALTAIR's crab tanks were considered insignificant to the extent that the results of the analysis could logically be applied to both vessels. The absence of distress messages or information from the vessels

suggested to Prof. Adee sudden, catastrophic demises. His analysis of the shapes of the stability curves corroborates this hypothesis. He explained the stability curves are fairly sharply sloped up to the angle of heel at maximum righting arm. This high initial stability would cause stiff handling, or fairly high accelerations, and the handling or behavior of the vessels would not indicate problems of instability to persons on board. The motions of the vessels, even at high angles of heel, would likely feel the same as they had during previous voyages. Beyond the angles of heel at maximum righting arm, the stability curves fall off at relatively steep rates. Prof. Adee observed "because the curve comes down so fast, the vessels are likely to go to 180 degrees immediately."

The suggestion that the AMERICUS and ALTAIR capsized remained after completion of the initial stability analysis. The results, however, did not reveal how or why the vessels capsized even though, in the various loading scenarios, not all of the IMO criteria were met. Further investigation was indicated to look at the following:

a.(i) Compare the natural response period of the vessel with the frequency of the waves to explore the possibility of synchronous rolling. Under these circumstances, a natural frequency phenomenon resulting in the build up of a very large dynamic response for a very small portion of functional input could have occurred.

a.(ii) Evaluate the effect of rudder use on the dynamic response of the vessel. Turning into a wave as a vessel begins to capsize initially causes the vessel to heel further into the wave, rather than heel back the other way. Pictures of the AMERICUS, capsized, show her rudder to stbd. (Note: Seas were off the stbd beam.)

a.(iii) Consider pseudostatic angle of heel - the dynamic phenomenon of a vessel, under certain conditions in beam seas, rolling into waves and being held at an assumed angle by water over the deck edge. The passage of subsequent waves further heels and holds the vessel until it capsizes into the waves.

b. Evaluate the effectiveness of the IMO criteria to consider whether it provides adequate stability for crab boats.

c. Verify the basic assumption of the ANTARES lightship displacement (289.3 tons).

38. IMO Criteria:

Mr. George C. Nickum, Chairman of the Board, Nickum & Spaulding Assoc., Inc., was the only U.S. delegate to the Inter-Governmental Maritime Consulative Organization (IMCO, now IMO) Maritime Safety Committee formed in 1964 to promulgate recommendations on intact stability of fishing vessels. Over the course of the next four years the committee, made up of members from approximately 25 nations, met 17 times, ultimately establishing the criteria by which the AMERICUS and ALTAIR were designed. The committee studied the stability of approximately 80 vessels, 20 of which had capsized, in order to establish parameters which exceeded characteristics of the casualty population. This method was used by Dr. Rahola of Finland in his 1938

STABILITY INVESTIGATION
F.V. AMERICUS - PHASE 1

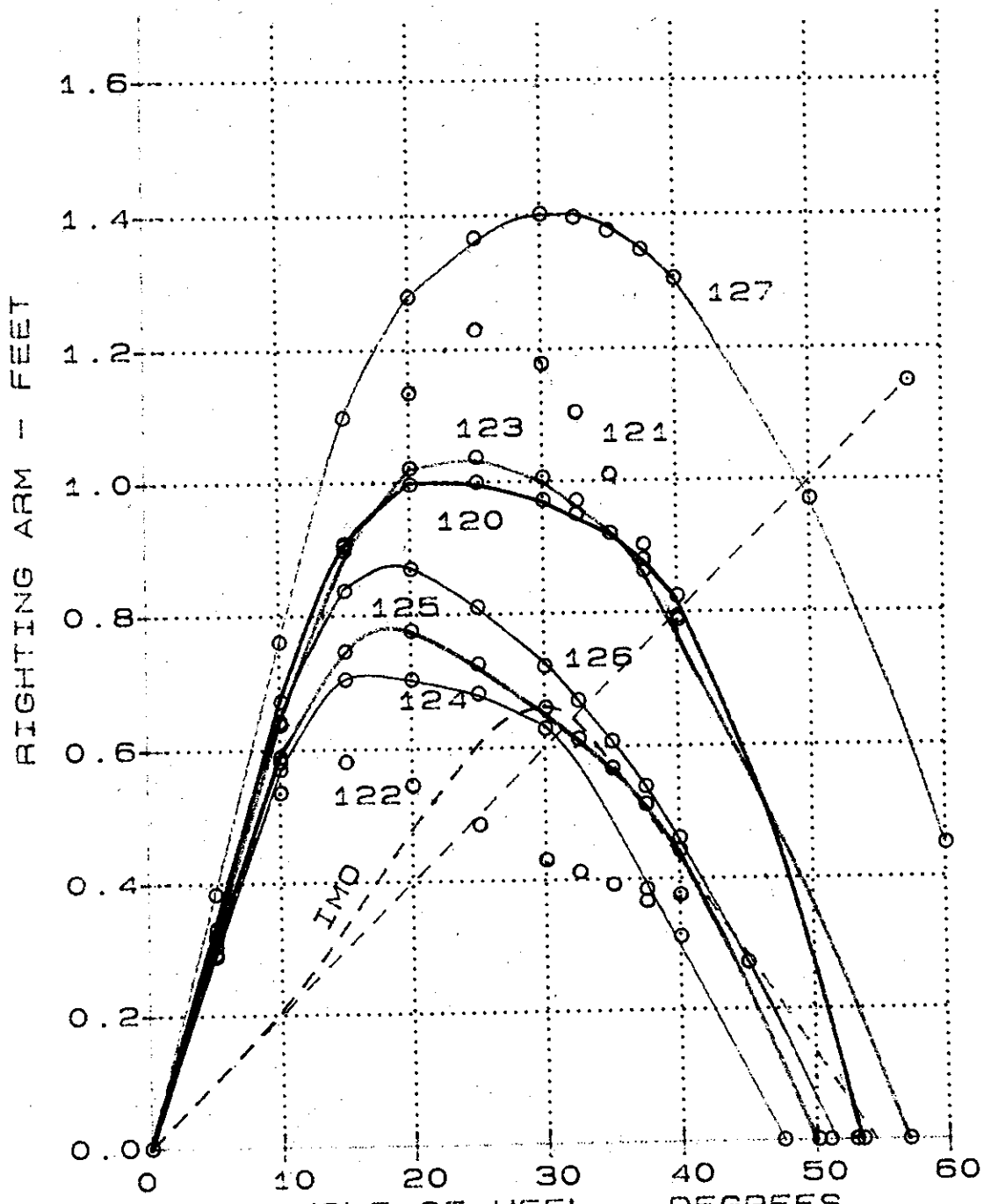


FIGURE 3

doctoral thesis, and was felt to represent the only rational basis by which safe criteria could be defined. The 80 vessels studied ranged in length from 24 to approximately 65 meters. None were crab vessels.

The following discussion on the origin and importance of each parameter was offered by Mr. Nickum:

a. (The area under the righting lever curve should not be less than .055 metre-radians up to a 30° angle of heel.) This figure came about as the result of the work of the Danish on some of their fishing vessels, and was corroborated in the analysis of the 80 vessels studied by the committee. The .055 metre-radian criterion was defined to ensure sufficient initial stability up to the 30° point and eliminate the situation of a slowly rising, relatively flat GZ curve which was characteristic of some of the casualty population.

b. (The area under the righting lever curve should not be less than 0.09 metre-radians up to a 40 degree angle of heel, or the angle of flooding if this angle is less than 40 degrees.) The committee considered the Rahola parameter of 0.08 metre-radians, but analysis of the casualty population revealed some ships that were lost were very close to 0.08. The parameter was therefore modified to 0.09 to provide a further margin.

c. (The area under the righting lever curve should not be less than 0.03 metre-radians between the angles of heel of 30 degrees and 40 degrees, or between 30 degrees and the angle of flooding if this angle is less than 40 degrees.) The angle of flooding was considered to be very critical by the committee. This parameter was established to ensure an angle of downflooding preferably greater than 40 degrees, and avoid the prospect of the GZ curve dropping off excessively.

d. (The righting lever GZ should be at least .20 metres at an angle of heel equal to or greater than 30 degrees.) This was a Rahola figure, and was found to be adequate in comparison to the casualty population.

e. (The maximum righting arm should occur at an angle of heel preferably exceeding 30 degrees, but not less than 25 degrees). The 30 degree figure was a Rahola recommendation. A large number of vessels analyzed outside the casualty population which otherwise met the criteria being considered had maximum righting arms occurring between 25 and 30 degrees. It was felt that excluding these vessels was not necessary for establishing minimum safety standards. The wording of this item was to encourage a 30 degree figure, but allow a 25 degree minimum.

f. (The initial metacentric height should not be less than 0.35 metres.) This parameter, thought by Mr. Nickum to be unnecessary if a vessel met the other criteria, was included at the insistence of some of the other delegates.

Mr. Nickum explained these criteria, combined, establish safe limits, and that excessive values in one area would not compensate for deficient values in

others. He did allow as an exception, calling for judgement, the prospect of maximum righting arm occurring at slightly less than 25 degrees if the difference in righting energy between the maximum and 25 degrees was very little. Mr. Nickum knew of only one vessel (a 180-ft. Danish Coaster) which had met the IMO criteria, yet still capsized. This particular vessel was running light in following seas (sea height and other particulars unknown). Prof. Adee, in the process of conducting extensive model testing, has observed it is far easier to induce capsizing in stern quartering or following seas than it is in beam seas. Both Mr. Nickum and Prof. Adee feel the IMO criteria on Fishing Vessel Stability is an effective design tool, historically proven. Neither identified a weakness or shortcoming in the criteria which might explain the loss of AMERICUS and disappearance of ALTAIR.

39. *SYNCHRONOUS ROLLING:*

Prof. J. Randolph Paulling was retained by Jeff Hendricks & Assoc. to evaluate the stability of the AMERICUS (intact) in the assumed loading conditions. The fixed lightship weight and loading upon which his studies were based was the same information used by Prof. Adee during Phase One of the stability investigation. Of the static stability analysis of the AMERICUS in the various loading conditions, Prof. Paulling observed:

> "Assuming that the weight and loading estimates are reasonably accurate, the results from these computations do not seem to give cause for alarm. The slight failure to meet the angle of maximum righting arm criterion is offset by the surplus in each of the other criteria. The excess area under the curve is considered the most significant since this is a good measure of the ability of the vessel to survive a sudden dynamically applied disturbance. With the exception of Condition 122, the area criterion is satisfied by all conditions of loading."

Although evidence indicating the AMERICUS and ALTAIR were subjected to minimum beam seas is considered certain, there was academic interest in studying the possibility of vessel losses due to synchronous rolling. To that end, Prof. Paulling, who developed the CAPSIZE program, was uniquely qualified to evaluate static stability in following seas, and dynamic motion in stern quartering seas.

In the case of a vessel proceeding in following seas, at times the crest of a wave will be near amidships. The underwater area of the hull is then substantially different than it is in a static state, and the righting arms are correspondingly less than they would be at equal angles of heel in calm water. By the same token, in the trough of a wave there would be an increase in righting arm. As the waves slowly overtake the ship, or vice versa, the characteristics will alternate between states of enhanced and diminished stability. If the speeds of a ship and following seas are nearly equal, the ship can remain on the crest of a wave, vulnerable, for an appreciable time.

Prof. Paulling computed righting arms for the crest amidships position in loading conditions 120, 122, and 124. Waves of length equal to ship length, and wave heights of four and eight feet were used. The plot of righting arm curves, corresponding to eight foot waves, showed substantial stability reduction for conditions 122 and 124, but condition 120 maintained positive stability over a significant range. Prof. Paulling observed:

"The substantial reduction in stability experienced by these vessels in following seas is characteristic of the raised forecastle, low stern fishing vessel form. The effect of differences in loading condition is somewhat less, in absolute magnitude, than the effect seen in the still water stability curves. If a considerable degree of uncertainty remains in the estimated loading conditions, this may provide a possible explanation for the loss. Since a certain degree of randomness is associated with the ship being in the critical position on a wave, the probability of this occurring in the case of both vessels seems remote."

The computation of dynamic motion in following seas involved use of a computer based simulation of the large-amplitude motion of a ship moving in following seas. The computation simulated rolling motions up to and including capsizing. The simulation was carried out for conditions 120, 122, and 124, using wave heights of four, six, and eight feet. The wave length was kept equal to the ship length. In addition to using the initial GM as determined in the static stability computations (base stability), one-half the base value and three-quarters of the base value were figured and run as alternate conditions. The results did not show a capsizing occurrence in any case utilizing the base value GM.

PHASE 2 (30 July 1983 - 19 December 1984)

40. The basic assumption of the lightship condition upon which stability calculations to date had been performed remained the only obvious facet of the investigation not yet corroborated. The decision to incline one of the sister vessels was made. The first to become available was the F.V. MORNING STAR, owned and operated by Mr. Dave Stanchfield. The MORNING STAR, identified among the remaining sister vessels as the one most similar to the AMERICUS and ALTAIR, was built in 1978 and had subsequently undergone two drag gear conversions. The original stability booklet, based on the ANTARES inclining, was issued on 6 August 1978. The MORNING STAR stability booklets contained the following data:

Revision No.	Date	Lt. Ship Wt.	VCG	LCG	Max. Pot Capacity
original	6 Aug 78	289.3 tons	14.78'	49.98'	258*
01	17 Mar 80	312.8 tons	15.63'	50.65'	239**
02	4 Aug 81	316.57 tons	15.69'	50.59'	239**
03	7 Dec 81	316.57 tons	15.69'	50.59'	232***

* Six tiers on deck
** Five tiers on deck, 40 pots in crab tanks (owner preference)
*** Six tiers on deck, 40 pots in crab tanks (corrects stability booklet to accurately reflect maximum capacity relative to available deck space)

Revisions to the MORNING STAR stability booklets were made by Mr. Fisker-Andersen. He did not incline the MORNING STAR, or perform deadweight surveys. He obtained the weight figures from Dakota Creek Industries.

41. The MORNING STAR was inclined by Prof. Adee at Dakota Creek Industries on 30 July 1983. The vessel was on a tight time schedule, and in order to conduct the experiment it was necessary to weigh and measure (with respect to vertical, longitudinal, and centerline references) numerous items on board.

Although there was insufficient time to strip the vessel to what would have been an ideal lightship condition, most of the heavy items were removed by use of a yard crane and four workmen. The presence of the remaining shipboard equipment (10.694 tons) and the total tankage (53.67 tons) was deducted from the inclining weight in order to compute the lightship weight. The following results were obtained:

Lightship estimate	VCG	LCG
372.236 tons	16.49'	53.27'

42. The AMERICUS-ALTAIR drag gear conversions (35.2 tons) amounted to a greater addition of weight than what the MORNING STAR underwent (27.3 tons). The major differences between the three were that the AMERICUS and ALTAIR each had a gantry at the stern, steel deck plating at the false deck aft, and rubber bumpers around the stern bulwarks. The newly revised AMERICUS parameters, based on the MORNING STAR incline and adjustments for the drag gear conversions differences, were:

Lightship displacement	VCG	LCG
380.00 tons	16.57'	54.26'

43. The disparity between the MORNING STAR's lightship displacement and the original lightship displacement based on the ANTARES' inclining was approximately 55.6 tons. Accuracy of the MORNING STAR results, especially when compared with the AMERICUS displacement estimates based on eyewitness accounts (Task 130), was considered questionable, and a follow-up inclining was felt to be necessary. That opportunity occurred with the F.V. VIKING EXPLORER, another sister vessel, in 1984. The VIKING EXPLORER was owned by Mr. Kaare Ness, then President of the North Pacific Fishing Vessel Owners' Assoc. The vessel was undergoing a drag gear conversion at Dakota Creek Industries. Prof. Adee conducted a deadweight survey on the VIKING EXPLORER, prior to conversion, and obtained the following estimates:

Lightship displacement	LCG
346.8 tons	49.23'

This displacement estimate suggested a net displacement gain of approximately 57.5 tons. On 19 May 1984, after installation of the drag gear (weight then unknown), Mr. Fisker-Andersen inclined the VIKING EXPLORER and obtained the following results:

Lightship displacement	VCG	LCG
376.65 tons	16.21'	51.55'

44. The VIKING EXPLORER calculations seemed to corroborate the MORNING STAR figures, and the lightship estimates of both these vessels suggested the assumed displacement of the AMERICUS, based on the ANTARES inclining, might not be accurate. This possibility, however, was inconsistent with displacement estimates (which, in effect, affirmed the ANTARES lightship weight) based on eye witness accounts of the AMERICUS' waterline upon her departure from Dutch Harbor. An attempt to resolve the matter involved verifying the position of the boot top stripe on the hull. Mr. Bob Gudmundson of Dakota Creek Industries was queried, and reported the top of the boot top stripe was at the top of the 10 foot draft mark forward (14 feet above the baseline), and at the bottom of the 14 foot draft mark aft (aft draft readings

measure actual distance above the baseline). Comparing where the stripe appeared on the Outboard Profile blueprint to the vessels, it was actually painted six inches higher on the hulls. This was done in order to protect the hulls by extending the bottom anti-fouling paint further up the sides. The effect, with regard to displacement estimates based on the eyewitness accounts and the incorrect location of the boot top stripe, was the illusion that the AMERICUS was sitting higher in the water, displacing about 36 to 40 tons less.

45. Having established a basis for concluding the ANTARES lightship condition, revised to include added drag gear, did not accurately reflect the displacement of the AMERICUS as she sailed from Dutch Harbor, the Board directed evaluation of the AMERICUS' stability utilizing a lightship estimate based on the MORNING STAR incline calculations. The Stability Work Statement was modified by way of changing crab pot size (now 7' x 7' x 32", weighing 690 pounds each, vice 7' x 7' x 34", 700 pounds), changing fuel amounts in various scenarios to accurately reflect the best estimates of amounts on board, and adding/deleting other work. As in Phase One, the evaluation involved analysis of the following tasks:

a. Task 120 (as before).

b. Task 121 (as before).

c. Task 124a - Estimate loading of the AMERICUS as in Task 120, but substitute the following fuel distribution:

Double Bottom Tanks (4)	Empty
Deep Tank Centerline	Empty
No. 2 Wing Tanks P & S	25%
No. 3 and 4 Wing Tanks P & S	Full
Fuel Oil Settling Tank	85%

d. Task 124b - Estimate loading of the AMERICUS as in Task 124a, but assume all crab tanks are full.

e. Task 130 (as before, utilizing corrected boot top location).

f. Task 140 - Using the loading condition in Task 120, considering the effects of trim with heel, determine the angle of heel at which the main deck submerges.

Completion of work for Tasks 122, 123, 124, 125, and 126 was deemed unnecessary. Prof. Adee added Task 500, which modifies Task 124a by adding stores and shipboard equipment, based on the MORNING STAR having on board stores and other gear which exceeded the previously estimated amounts.

46. Analysis of the loading conditions identified above yielded the following:

				Draft (above baseline)	
Task	Displacement	VCG	LCG	Fwd.	Aft
120	729.10 tons	15.14'	58.18'	13.53'	14.04'
121	599.97 tons	16.06'	57.83'	11.82'	12.81'
124a	731.62 tons	15.51'	59.02'	13.08'	14.46'
124b	860.75 tons	14.86'	59.14'	14.70'	15.73'
500	746.15 tons	15.83'	58.30'	13.41'	14.50'

47. The GZ curves for the AMERICUS, assuming loading conditions listed in paragraph 45 and a lightship weight based on the MORNING STAR inclining, are plotted in Figure 4. The following table contains a comparison of the AMERICUS, under these conditions, with the IMO criteria. (Note: "*" indicates a failure to meet the criterion):

	Area Under Righting Lever			Rt. Arm	Heel at Max.	Init.
Task	0-30°	30-40°	0-40°	@ 30°	Rt. Arm°	GM
120	11.922	2.101*	14.023*	0.311*	15*	2.98'
121	15.875	4.073*	19.948	0.605*	20*	2.76'
124a	8.015*	nil*	8.015*	0.005*	13*	2.56'
124b	nil*	*	nil*	*	5*	3.04'
500	5.117*	0.000*	5.117*	*	11*	2.24'

48. (Task 130) - Utilizing the corrected location of the boot top stripe, the following revised estimates of the AMERICUS draft and displacement, based on eye witness accounts of her departure from Dutch Harbor, were:

Draft aft: 14.0 ft. (ABL)
Draft fwd: 13.75 ft. (ABL)
Displacement: 736.725 tons

Calculations for the load conditions listed in Tasks 120, 124a, and 500 yield displacements close to this estimate. The load in Task 121 is too light, and in Task 124b too heavy.

49. Deck edge submergence results in a rapid loss of stability due to the introduction of water on deck and a decrease in the underwater hull area which acts to right the vessel. If the vessel is of hard chine construction, an angle of heel which both submerges the deck edge and pulls the chine out of the water results in further reduction of water plane and stability. Calculations from Task 140 indicate the AMERICUS (assuming loading as in Task 120 and lightship displacement based on the MORNING STAR incline) would have experienced deck edge submergence at a 7 degree angle of heel at the location of minimum deck height (62 feet aft of the forward perpendicular).

50. ANALYSIS:

The most significant item resulting from Phase 2 of the investigation is the difference in the estimated displacement of the AMERICUS. Analysis of the MORNING STAR and VIKING EXPLORER displacements, and revised estimates of the AMERICUS displacement based on eyewitness accounts and the correct location of the boot top stripe, suggest a dramatic increase over the original ANTARES lightship displacement. Prof. Adee offered the following opinion:

> "I believe the major contributing factor of the resulting capsizing or the loss of these vessels was the lack of static stability because the vessels were very heavily loaded. There may have been contributing factors, including the fact that at seven degrees the vessels begin to take water on deck and in a seaway it is possible that this could further compromise their stability...I am assuming the AMERICUS was probably sailing with the double-bottom tanks empty...I think the vessel would be much more likely to capsize with the double bottom tanks empty...and not with the double bottom tanks full."

STABILITY INVESTIGATION
F.V. AMERICUS - PHASE 2

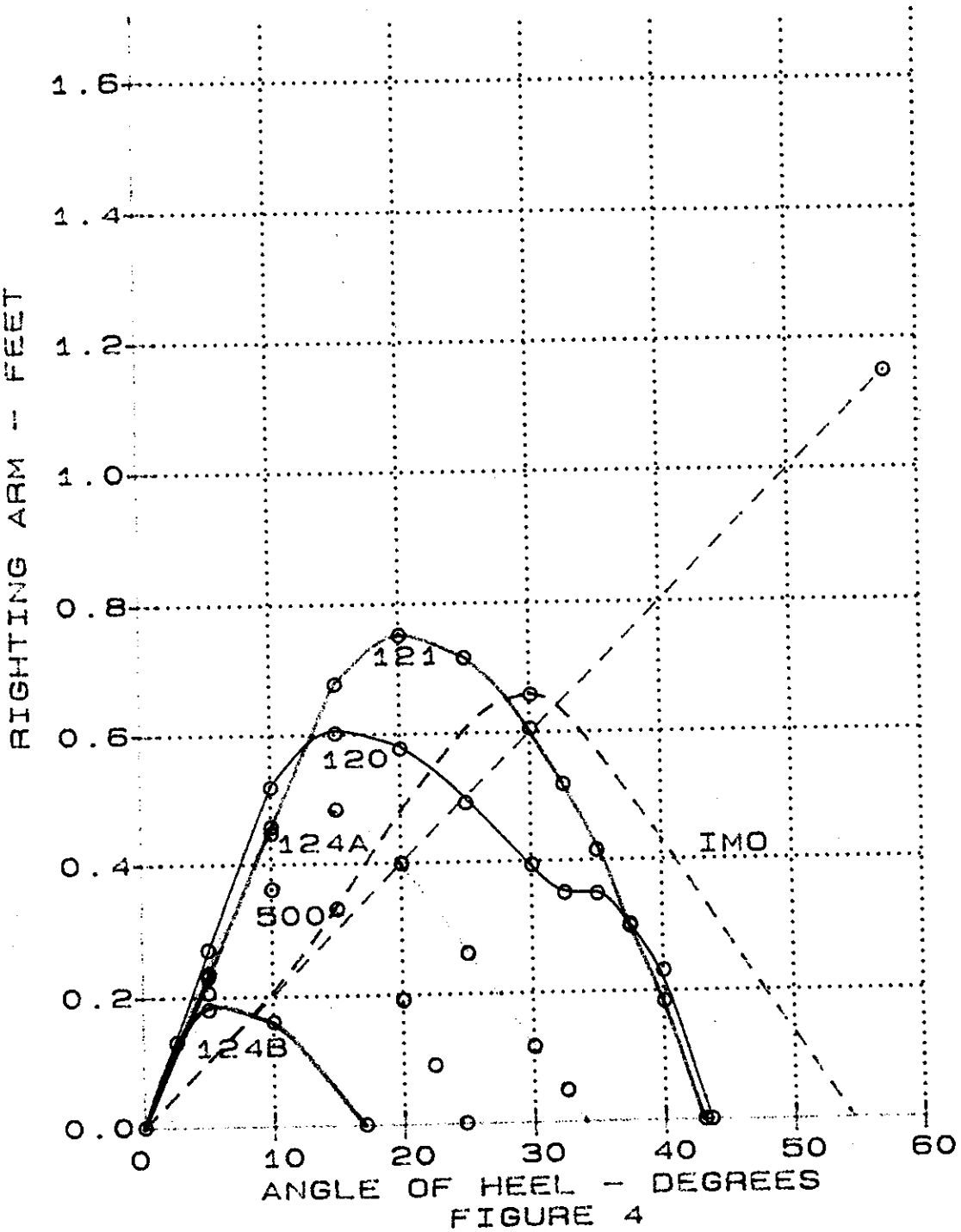


FIGURE 4

In offering a scenario, Prof. Adee believes the vessels, sailing with winds and seas off the stbd beam, frequently took water on deck on the stbd side. He feels the vessels heeled into the waves and didn't have sufficient stability to return upright. Continuing underway, the vessels were no longer rolling about an upright equilibrium position, but rather about an assumed (psuedostatic) angle of heel. The initial GM remained high and exceeded the IMO criteria for all studied loading conditions. Prof. Adee observed:

> "The loss of stability doesn't show as a tremendous change in the metacentric height. It shows in the (GZ) curve at large angles because they (the vessels) lack freeboard. It shows that the curve at large angles disappears...I think on the basis of the initial stability of the vessels they (the crews) probably would not have perceived anything greatly out of the ordinary because the boats still have some significant amount of initial stability so their small angle-rolling would not have been greatly affected. In fact I think the perception that I have seen among fishermen, that a more comfortable rolling is more stable, probably would have been reinforced. They may have perceived getting a bit lower and a period of rolling a little longer but probably would have thought that the vessel was more sea kindly under those circumstances, but it wouldn't be until they got to a large angle of heel where they would feel the vessel was sort of hanging at the edge of a cliff."

Prof. Adee has found through interviews with fishermen as well as model testing at the University of Washington that the instinctive reaction of a helmsman, perceiving the danger of capsizing (commonly a heavy roll from which the vessel does not recover, with capsizing occurring within a couple of subsequent roll periods), is to turn the rudder hard over, in the direction of the heeling, to try to correct the situation. The rationale behind this action is to use centrifugal force to flip the vessel back the other way and head up into the wind and waves. However, the initial movement of the rudder creates the opposite effect. It is only after the vessel has begun to turn that the desired effect occurs. Prof. Adee commented:

> "We have found with our model experiments that turning the rudder hard over, as you'd expect, generally tends to contribute to the capsizing. The initial effect is to further upset the vessel. In fact, it seems possible that this could have happened with the rudder position of the AMERICUS as shown in the capsized position...The best thing we've found to do (when the person at the helm perceives that he's going to capsize) is leave the rudder amidship, don't make any fast moves with the rudder, and cut power and let the vessel's own natural ability right itself. Its own basic stability, even if it's only very small, generally saves the vessel or has a better chance of saving the vessel than trying to correct imminent capsize."

Mr. Glen Treadwell was serving as master on the F.V. ANDREW MCGEE (a sister vessel to AMERICUS and ALTAIR) in July 1984. The vessel was working off the coast of Washington at that time. All four crab tanks on the ANDREW MCGEE were full. One morning, while walking across deck before assuming the watch, Mr. Treadwell observed the overboard discharge of water and thought back to what he observed on the ALTAIR in Dutch Harbor. The association led him to believe ALTAIR may have sailed from Dutch Harbor with all four crab tanks

full. Mr. Treadwell's recollection was not communicated to the Board until 26 September 1984. Prof. Adee concluded cross-tanking alone was detrimental to AMERICUS' stability due to reduction of freeboard, and that the flooding of all four crab tanks on ALTAIR would have constituted an even greater adverse impact on stability.

51. DISPLACEMENT INCREASE:

The amount of the displacement increase (55.6 tons, 19% of the original lightship weight) was far in excess of what might be expected as natural gains over the first few years of service. While seeking an explanation of this phenomenon, it was learned that Jeff Hendricks & Assoc. had Mr. Fisker-Andersen incline the ALYESKA on 31 January 1984. Previously, on 10 March 1983, Mr. Fisker-Andersen revised the ALYESKA stability booklet to include her later drag gear conversions. These computations were without the benefit of a deadweight survey or inclining experiment. The weight of the drag gear was obtained from Dakota Creek Industries. The ALYESKA stability booklets contain the following:

Revision No.	Date	Lt. Ship Wt.	VCG	LCG	Max. Pot Capacity
Original*	5 NOV 74	301.4 tons	13.25'	51.9'	258
01	10 APR 81	313.6 tons	14.14'	52.4'	228
02	10 MAR 83	336.03 tons	14.69'	53.84'	180
03	31 JAN 84	396.68 tons	14.82	52.85'	144

* Inclining of sister vessel F.V. AMERICAN EAGLE performed by Mr. Fisker-Andersen. The AMERICAN EAGLE and ALYESKA were built at the Fairhaven Shipyard (which is now out of business) in Bellingham, WA.

The results of ALYESKA'S incline showed, separate from the added drag gear, an apparent 60.65 ton displacement increase.

In attempting to account for the 55 - 60 ton displacement increases on three vessels (MORNING STAR, VIKING EXPLORER, and ALYESKA), accuracy of the original lightship parameters was questioned. An error resulting in too light a figure in the beginning would now contribute to an apparently greater displacement gain than what might have actually occurred. The ANTARES incline was conducted under ideal conditions. The vessel had recently been launched, and all of the tanks, sumps, and piping systems were dry. Dakota Creek Industries personnel reported construction of the ANTARES was completed before the incline was performed, and there were no final additions made to the vessel afterwards. The moment curve slopes (for weight movements during the inclines for both the ANTARES and AMERICAN EAGLE) plotted in straight lines. Prof. Adee found no evidence of a mistake during review of the original ANTARES-AMERICUS stability data. When asked of the probability of an error in the original lightship figures he did not completely dismiss the possibility, but expressed doubt since the ANTARES and AMERICAN EAGLE class both showed similar increases. He pointed out an error would have had to have been repeated in separate inclines.

Based upon original inclining data, the AMERICAN EAGLE, though smaller than ANTARES, by one foot less depth amidships, displaced 11.1 tons more. Mr. Fisker-Andersen commented he was surprised by the difference, and as a result double checked his ANTARES calculations to ensure accuracy. He satisfied

himself that heavier construction in the forecastle and main deck of the AMERICAN EAGLE accounted for the greater displacement, and that there was no error in his ANTARES calculations.

The F.V. OCEAN DYNASTY, another of the ANTARES-class vessels, was built by Dakota Creek Industries in 1979. Built with trawl fishing in mind, this vessel had more powerful main machinery and a larger pilothouse than the ANTARES. Because of these differences, Mr. Fisker-Andersen inclined the OCEAN DYNASTY. The fuel tanks and sumps were full. This was the only vessel in the ANTARES-class other than the ANTARES that was inclined upon completion of construction. The displacement Mr. Fisker-Andersen calculated was 15 tons greater than the ANTARES'. Mr. Gudmundson was asked to provide machinery and pilothouse weight differences between the two vessels, and estimated the OCEAN DYNASTY was 8.86 tons heavier than the ANTARES.

Prof. Adee estimates the incline he performed on the MORNING STAR is accurate to within ten tons, and that the corrections he made for various items on board and tankage are accurate to within a few tons. He feels his estimates of VCG and LCG are accurate to within a few tenths of a foot. His MORNING STAR LCG estimate is aft of the position Mr. Fisker-Andersen calculated for the VIKING EXPLORER by nearly two feet. When asked what bearing an error in the MORNING STAR'S LCG estimate of a foot or so would have on his subsequent stability calculations, he explained use of the constant trimming moment method, and felt an LCG within a few feet of the position he used would have a small affect on his calculations, but would not change the end results with regard to the conclusions drawn. Prof. Adee feels his VIKING EXPLORER deadweight survey is less accurate than his MORNING STAR incline.

The following items were considered as possible sources explaining the displacement increases:

a. The original lightship parameters could have been grossly in error, or accurate within acceptable limits (a few percentage points), while still being somewhat less than the true lightship.

b. The follow-on sister vessels, not inclined or given deadweight surveys when new, could have been heavier than the original vessels. Dakota Creek Industries personnel stated there were virtually no changes made among the ANTARES-class vessels. Prof. Adee, in discussing among colleagues possible weight differences between sister vessels, learned from Marine Construction and Design Co. (designers and builders of large fishing vessels), Seattle, WA, that follow-on ships in the 100-ft. class are generally heavier than the original vessel by maybe five to ten tons.

c. Cooling water in the skeg, for the controllable pitch prop, amounts to four tons. The skeg was full during the MORNING STAR and VIKING EXPLORER inclines, but empty during the ANTARES incline.

d. Tank clingage, bilge accumulations, fluids in the crab tank circulation systems and hydraulic piping, and full sumps represent differences which would add weight.

e. Water leaking into the crab tank lining, and absorption of water by wooden deck planking would add weight.

f. Piecemeal additions of miscellaneous equipment permamently installed could, during a reincline, appear to be a part of the original lightship.

g. Tools, spare parts, fishing gear (nets, wire, etc.) and other supplies would add weight.

h. Jeff Hendricks & Assoc. vessels were well maintained. They were hauled out nearly annually for servicing. The hulls were sand swept lightly and repainted during each yard period. It took approximately one ton of paint to cover the hulls. Repainting would have added a few tons over the lives of the vessels.

i. The accuracy of the drag gear conversion weights could impact on the apparent displacement increases if the estimates were less than the actual weights. Although Dakota Creek Industries personnel feel the estimates are accurate, the items added to the vessels during their conversions were not weighed at the times of installation.

Prof. Adee, in addressing the weight disparity, said: "I had been aware of the general comments that vessels get heavier with time...but not of this magnitude."

52. ALTAIR PHOTOS:

The November 1984 issue of the NATIONAL FISHERMAN contained an article about Prof. Adee's work on the AMERICUS-ALTAIR investigation. Mr. Charles B. Fortson, Panama City, FL, saw the article and sent Prof. Adee photos of the ALTAIR taken by him in December 1982. Mr. Fortson works for the Naval Coastal Systems Center (NCSC), and was doing survey work in Puget Sound at that time. The ALTAIR and F.V. STARWARD were on charter to the Navy for this work. The photos show the ALTAIR underway at slow speeds in calm water, and give a clear presentation of the boot top stripe with respect to the waterline. Mr. Fortson wrote:

> "During the tests I noticed ALTAIR was down by the bow and I asked Ron Biernes why. He said it was caused by the fuel load. I've enclosed three pictures that I made that show the trim real well, two of them at about 2 kts and one at about 6 kts (the wave system appears to indicate more speed but I think it was about 6 kts). You can see by the discharge over the side that his crab tanks were always full. He told us this is standard practice even when underway in calm seas (leaving the pumps going)."

Prof. Adee was asked to make a displacement estimate on the basis of the ALTAIR photos provided by Mr. Fortson. Jeff Hendricks was contacted for information on how ALTAIR was loaded during the Navy Charter. He checked invoices for the amounts of fuel, etc., purchased for provisioning ALTAIR prior to her February 1983 departure from Anacortes to Dutch Harbor, and provided the following:

Fuel on board at time of Navy Charter	12,349 gallons
Fuel distribution	4,000 gallons in forward settling tank, remainder in stern wing tanks.
Lube oil	472 gallons
Hydraulic oil	1,217 gallons
Fresh water	50%

For the purpose of completing the loading estimate, Prof. Adee made the following additional assumptions:

Crew provisions and stores	2.0 tons
Refrigerated stores	2.0 tons
Ship's stores	2.0 tons
Sewage	50%

The following estimates, using Navy Photo No. 55924-15 (Board Exhibit No. 182), were made:

Draft (ABL) at aft draft marks	12.91 ft.
Draft (ABL) at aft end of forecastle bulwark	14.23 ft.
Trim	2.55 ft. by the bow.
Estimated displacement based on waterline input	730.65 tons

Prof. Adee estimated the loaded displacement of the ALTAIR to be 699.96 tons. This was based on the lightship displacement from his MORNING STAR incline (taking into account that the Navy charter took place before ALTAIR's third conversion), plus adding weights for the above estimates of fuel, fresh water, etc., the forward net reel and drag winches, and all four crab tanks full. These calculations omitted ALTAIR's greater lightship displacement (7.6 tons) due to crab tank insulation. Although there remains a 23 ton difference between the photo and loading comparisons, Prof. Adee observed:

> "Within the (degree of) accuracy that we can even begin to claim, the answers, I think, are fairly consistent...The conclusion that I reached is that, indeed, the ALTAIR was similar to the results we've obtained for the MORNING STAR...the lightship was heavier than the ANTARES."

53. JACOB FISKER-ANDERSEN ANALYSIS

Mr. Fisker-Andersen questioned the results of the MORNING STAR incline when they were first made known. The item of greatest concern to him was Prof. Adee's estimate of the MORNING STAR's LCG, which he felt was too far aft and indicated that an error had been made.

On 1 June 1984, Mr. Fisker-Andersen performed an incline on the F.V. ANDREW MCGEE, another of the ANTARES-class vessels. The ANDREW MCGEE had not had any drag gear added. Mr. Fisker-Andersen calculated the following:

Lightship displacement	VCG	LCG
315.51 tons	14.71 ft.	49.29 ft.

Compared to the original ANTARES displacement estimate, the ANDREW MCGEE incline suggests a 26.2 ton increase, about half the amount implied from the MORNING STAR incline.

Dakota Creek Industries estimated the trawl or drag gear conversion weights for the VIKING EXPLORER to be 140,114 pounds - 62.5 long tons. This figure, not communicated to the Board until 7 January 1985, was obtained earlier by Mr. Fisker-Andersen. Deducted from the VIKING EXPLORER incline results of 19 May 1984, Mr. Fisker-Andersen obtained a weight before conversion estimate of 313.69 tons, which was within 1.82 tons of the ANDREW MCGEE's displacement.

Prof. Adee's analysis of the ALTAIR photos provided by Mr. Fortson was received by the Board on 19 December 1984. Mr. Fisker-Andersen, on his own volition, examined copies of those photos afterwards. On the basis of those photos, Mr. Fisker-Andersen assumed a mean draft of 11.6 ft. (waterline observed two inches below the white (boot top) stripe at the longitudinal center of flotation - two feet aft of the overflow), and estimated the displacement to be 683 tons. This is in contrast to Prof. Adee's estimate of 730.650 tons. Mr. Fisker-Andersen then deducted from 683 tons the weights representing fuel, fresh water, crab tank flooding, etc., arriving at the figure of 349.64 tons. Deducting from that the original ALTAIR lightship displacement (296.90 tons) and the weight of the drag gear on board at the time the photo was taken (27.2 tons), he ended up with a net weight gain estimate of 25.54 tons.

On the basis of the above analyses of the ANDREW MCGEE, VIKING EXPLORER, and ALTAIR, Mr. Fisker-Andersen felt a more correct estimate of weight gained during the service life of ANTARES-class vessels was 25 tons. He then conducted a stability analysis of the AMERICUS and ALTAIR, adding 25 tons plus the weight of the drag gear to the original lightship estimates. Stability characteristics of the vessels in the following loading conditions were then investigated:

AMERICUS

a. Condition 4H:

-Crab tanks cross-tanked	
-Fuel on board 34,168 gallons (46%) distributed as follows:	
No. 1 & 2 Double Bottom Tanks P & S	Empty
No. 2 & 3 Wing Tanks P & S	Empty
No. 4 Wing Tanks P & S	78%
Deep Tank Centerline	98%
F.O. Settling Tank	98%
-Fresh Water No. 1 P & S Wing Tanks	35%
-Contaminated oil tank	Empty
-Sewage tank	50%
-Lube oil tank	95%
-Hydraulic oil tank	95%
-Crew	1.25 tons
-Provisions and stores	12.0 tons
-Stores (frames 33-36)	3.0 tons

-Crab pots six tiers. First tier 87, tiers 2-6 @ 28 ea.
Total 227 pots @ 700# ea.

b. Condition 4X: - Same as Condition 4H except all crab tanks empty.

c. Condition 5H:

-Same as Condition 4H except for fuel on board (38,184 gallons, 46%) distributed as follows:

No. 1 & 2 Double Bottom Tanks P & S	98%
No. 2, 3 & 4 Wing Tanks P & S	Empty
Deep Tank Centerline	98%
F.O. Settling Tank	86%

d. Condition 6H: - Same as Condition 5H except all crab tanks empty.

ALTAIR

a. Condition 4I: - Same as AMERICUS in Condition 4H except all crab tanks full.

Mr. Fisker-Andersen's analysis of these conditions yielded the following:

				----Draft*----			
Cond.	Displacement	VCG	LCG	Fwd.	Aft	Mean**	Trim
4H	706.58 tons	15.14'	58.61'	9.58'	14.03'	11.85'	0.95'
4X	571.03 tons	16.15'	58.31'	7.62'	12.64'	10.20'	1.51'
5H	706.63 tons	14.62'	56.55'	10.51'	13.27'	11.85'	-0.74'
6H	571.08 tons	15.51'	55.76'	8.78'	11.88'	10.31'	-0.40'
4I	838.37 tons	14.44'	59.04'	11.02'	15.40'	13.25'	0.88'

* Draft readings measured at draft marks from keel. Keel at aft draft marks is at baseline. Keel at forward draft marks is 3.5 feet above baseline.
** Draft at longitudinal center of flotation.

The following table and Figure 5 compare the stability characteristics of the vessels, under these loading conditions, with the IMO criteria. (Note: "*" indicates a failure to meet the criterion):

	Area Under Righting Lever			Rt. Arm	Heel at Max.	Init.	Required
Cond	0-30°	30-40°	0-40°	@ 30°	Rt. Arm°	GM	GM #
4H	12.95	1.46*	14.41*	0.29*	15*	3.08'	4.55'*
4X	17.16	3.83*	20.99*	0.64*	22.575*	2.44'	3.00'*
5H	18.77	6.81*	25.58*	0.74*	19*	3.68'	3.95'*
6H	21.68	8.86	30.54	1.04	26	3.15'	3.00'
4I	3.94*	-*	3.94*	-*	9-10*	3.47'	5.75'*

\# The initial GM IMO criterion of 1.148 ft does not necessarily provide for adequate stability at large angles of heel. Mr. Fisker-Andersen's definition of "required GM" is that amount necessary to ensure that each of the IMO criteria are met.

Mr. Fisker-Andersen scribed waterlines, based on draft readings obtained for his various loading conditions, on an Outboard Profile drawing corrected to show the proper boot top location. He had determined where the boot top was painted on the hull by analyzing pictures of the AMERICUS capsized, and identified the same boot top location reported by Mr. Gudmundson. Mr. Fisker-Andersen testified the waterline represented by his condition 4H

matched that described by the witnesses who observed the AMERICUS departure from Dutch Harbor. Mr. Fisker-Andersen further stated that results of his analysis suggest the double bottom tanks on the AMERICUS were empty, and the crab tanks were cross-tanked.

54. The main difference between the analyses of Prof. Adee and Mr. Fisker-Andersen is the magnitude of the weight gain aside from the drag gear. Prof. Adee's estimate exceeded Mr. Fisker-Andersen's by about 30 tons. At approximately 7.5 tons per inch immersion between the 13 ft. and 14 ft. hull marks, the difference between their scenarios translates to about four inches in draft.

55. There is no jurisdiction to promulgate regulations prescribing when the stability of fishing vessels should be evaluated. The practice of relying on the inclining data of the first of a series of sister vessels, without verifying displacement of the later or follow-on vessels, appears to be common industry practice. There are, likewise, no established fishing industry guidelines specifying when stability should be re-evaluated in the case of a vessel being modified. The Twelfth District Merchant Marine Technical Branch provided the Board with the following summary of Coast Guard policy concerning weight additions and removals on inspected vessels:

a. If the total of weights added plus weights removed is less than one (1) percent of the lightship weight, no inclining experiment or deadweight survey is required.

b. If the total of weights added plus weights removed is between one (1) and ten (10) percent of the lightship weight, a deadweight survey is required.

c. If the total of weights added plus weights removed is over ten (10) percent of the lightship weight, a new inclining experiment is required.

56. Paragraph 7.2(iv) of the IMO Recommendations on Intact Stability of Fishing Vessels discusses the desirability of enabling a ship's master to determine the initial metacentric height (GM) using a rolling test. The procedure involves timing the rolling period (one complete oscillation) of the vessel, and factoring the results in the following formula:

$$GM = \frac{F}{T \times T}$$

"F" is a coefficient which takes in account the influence of the distribution of the various masses in the whole of the body of the ship. "T" is the rolling period in seconds. The test should be conducted in a sheltered harbor, rather than open waters, to eliminate forced rolling influenced by sea conditions.

Mr. Fisker-Andersen included the above formula in the stability booklets of the vessels which have been named in this investigation. The "F" value he uses is 200. Personnel presently or formerly associated with the operation of ANTARES, AMERICUS, ALTAIR, MORNING STAR, VIKING EXPLORER, ANDREW MCGEE, and ALYESKA were questioned about use of the formula and the correlation between

JACOB FISKER-ANDERSEN ANALYSIS

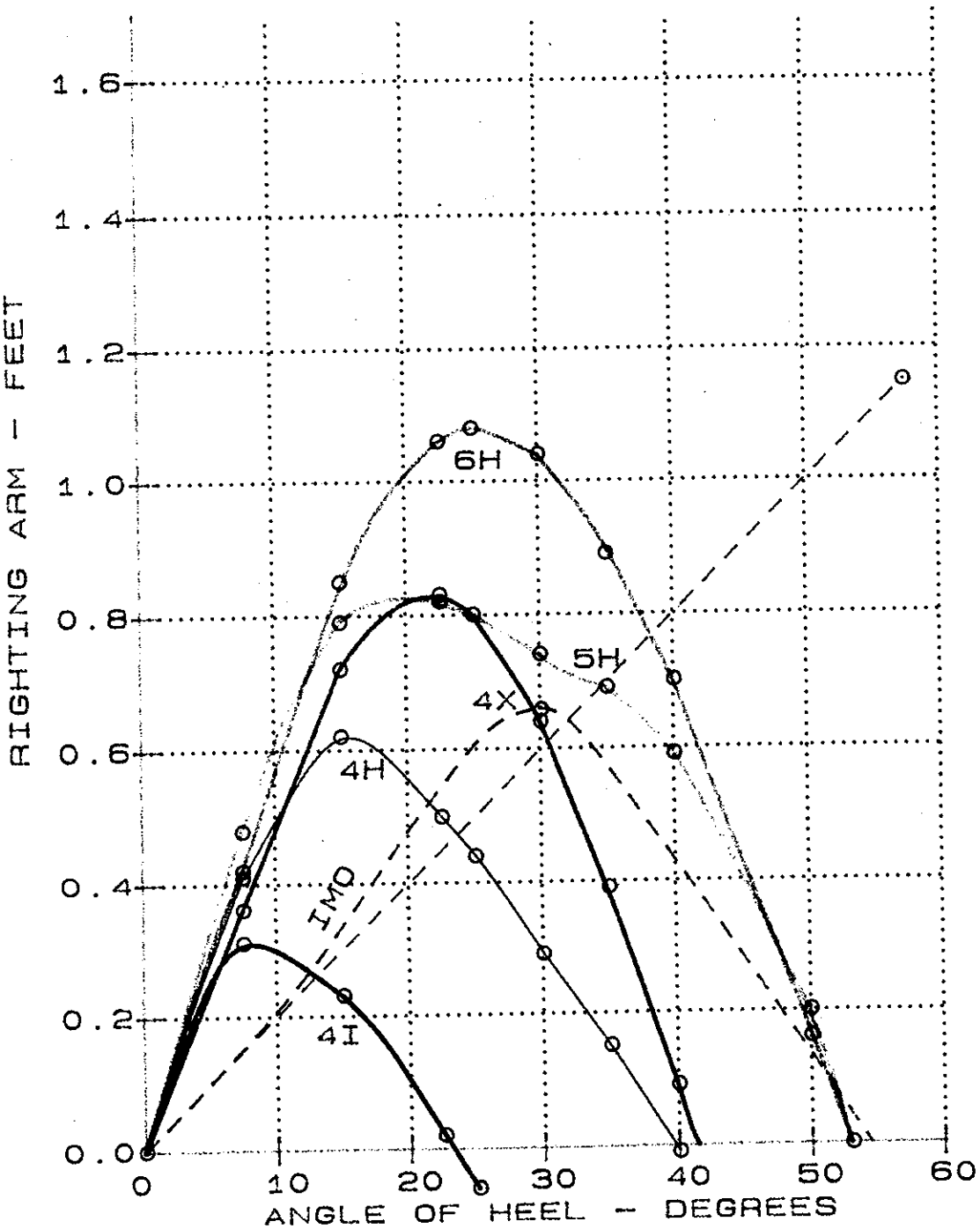


FIGURE 5

roll period and vessel stability. None have used the roll period test, and none expressed an understanding of its purpose.

57. Prof. Adee is Director of the Fishing Vessel Safety Center at University of Washington. In recent years he has traveled extensively through the northwest to conduct fishing vessel stability seminars. He has worked closely with many fishermen. In assessing the general degree by which fishermen use and rely on stability data, Prof. Adee commented:

> "In my opinion I find them very deficient in the knowledge of stability...in talking to people involved in trying to use them (stability booklets), generally they seem to be overwhelmed."

CONCLUSIONS

1. The lack of survivors or witnesses to the accidents, and the lack of vessels to examine, necessitated the Board's reliance on indirect evidence and supposition. Although the conclusions drawn may be challenged, the Board feels the explanation for the losses of AMERICUS and ALTAIR has been identified.

2. Observations of the inverted AMERICUS hull, which revealed no apparent damage, and analysis of various loading conditions suggest each vessel suffered instability and capsized. Prof. Adee's conclusions concerning loading, the role of deck edge submergence, heeling into seas, and the effects of rudder usage are considered to accurately describe how both the AMERICUS and ALTAIR were lost.

3. The seven-man crews from AMERICUS and ALTAIR are missing and presumed dead as a result of these casualties.

4. The hull (with red boot topping) sighted by the NEPTUNE JADE at 1510, 14 February 1983, was the AMERICUS.

5. The hull sighted by the OCEAN BROTHER at 1608, 14 February 1983, was the AMERICUS.

6. The AMERICUS is concluded to have capsized at approximately Lat 54°18.2N, Long 166°43W, at approximately 1110, 14 February 1983. This assumes a 0830 departure from Dutch Harbor, a course of 340 degrees (heading towards the Pribilofs), and a rate of speed of 10 knots. Following is a summary of dates, times, and locations the capsized AMERICUS was sighted:

DATE	TIME	REPORTING VESSEL	LAT (N)	LONG (W)
2/14	1510	NEPTUNE JADE	54°19.6'	166°54'
2/14	1608	OCEAN BROTHER	54°17'	166°58'
2/15	0800	GOLDEN PISCES	54°17'	167°22'
2/15	2345	ALYESKA	54°16.5'	167°34.5'
2/16	1130	ALLIANCE	54°24.5'	168°21.8'

The capsized AMERICUS drifted on a course of 278.5 degrees at a rate of approximately 1.25 mph. The projected time and location of capsizing is estimated to be the intersection of the assumed course and speed out of Dutch Harbor, and the reciprocal of the drift rate and course of the capsized hull.

7. The time and location of the loss of ALTAIR is unknown and cannot be determined.

8. The ALTAIR hull was not sighted capsized.

9. The following factors are identified as having contributed to apparent unstable conditions on board AMERICUS and ALTAIR.

a. Drag gear conversion
b. Apparent weight gain above and beyond the drag gear conversion
c. Crab tank flooding
d. Fuel distribution

The carriage of crab pots, adding approximately 70 tons to each vessel, also had a negative impact on stability, but is not categorized as contributing to instability since crab fishing was the service of the vessels.

10. The amount of the weight gain (or displacement increase) above and beyond the weight added by the drag gear conversions is unknown. It appears to have been at least 25 tons, and there is reliable evidence suggesting it could have been much greater. The disparity between the analyses of Prof. Adee and Mr. Fisker-Andersen amounts to only a four inch waterline difference. Since there are corroborating inclines supporting the magnitude of the increase in each scenario (Prof. Adee: MORNING STAR, ALYESKA; Mr. Fisker-Andersen: VIKING EXPLORER, ANDREW MCGEE), and estimates of waterlines on the basis of eye witness testimony and photographic evidence cannot be considered precise, the weight gain represented by either scenario is considered possible.

11. In attempting to account for the weight gain apart from the drag gear, the possibility of a serious error in the ANTARES' inclining is considered unlikely. Mr. Fisker-Andersen's double-checking the ANTARES results against the AMERICAN EAGLE, and obtaining an OCEAN DYNASTY displacement, corrected for estimated main engine and pilothouse weight differences, within approximately 6.14 tons of ANTARES suggests the inclines he performed were reasonably accurate.

12. While items a-i in paragraph 51, Findings of Fact, address logical sources of displacement increases, it is not possible to determine how much each item contributed to the total. It is likewise not possible to know whether other items may have contributed to the total. More important than understanding the sources of the increase, however, is an awareness that displacement changes have occurred.

13. Although the weight increase separate from the drag gear conversion was unknown until after losses of the vessels, it would have been detected had deadweight surveys or inclines been performed upon completion of the various modifications.

14. The absence of jurisdiction over commercial fishing vessels does not allow for the imposition of regulations which apply to the inspected segments of our maritime industry. The practices of not verifying the displacement of follow-on sister vessels, and of not re-evaluating stability characteristics after major modifications, seem to be common. In the case of MORNING STAR and ALYESKA, even though modifications were made and the stability booklets were revised, it was done only on paper. The aforementioned practices reflect the absence of an industry standard to the extent that a lax approach to decision making defines the industry standard.

15. The presence of the drag gear on board and the existence of other weight in addition to the drag gear constituted fixed conditions over which the AMERICUS and ALTAIR masters had no control. Decisions with respect to how the vessels were loaded, specifically regarding fuel distribution and crab tank flooding, were factors under the immediate and direct control of the respective masters.

16. It is concluded the double bottom fuel tanks on both the AMERICUS and ALTAIR were empty upon their departures from Dutch Harbor and that, of the various factors which contributed to instability of the AMERICUS and ALTAIR, the empty double bottom fuel tanks were most detrimental. Comparison of curves 120 and 124a in Figure 4, and 4H and 5H in Figure 5, illustrates empty double bottoms result in substantial reduction of area under the GZ curves, as well as an approximate 10° reduction in the angle of heel necessary to produce a capsizing.

17. Corroborating information on the AMERICUS fuel distribution is gleaned from Mr. Brenengen's testimony indicating the AMERICUS engineer planned commencing his transfer "from a front tank with 8,000 or 10,000 gallons." There is not a front tank with 8,000 or 10,000 gallons on the AMERICUS, or any of her sister vessels. The record of the 13 February 1983 transfer of fuel from the ALYESKA (Board Exhibit No. 73) refers to the No. 1 port and stbd double bottom tanks as "the forward crab tank" - one tank. The No. 1 port and stbd double bottom tanks on AMERICUS, when full, hold 8,040 gallons. It is felt the AMERICUS engineer's comment referred to the forward double bottom tanks.

18. Cross-tanking of the AMERICUS reduced freeboard, contributing to an earlier deck edge submergence than would have occurred had the crab tanks been empty. Comparison of curves 120 and 121 in Figure 4, and 4H and 4X in Figure 5, illustrates that, although the area under the GZ curves is less with the crab tanks cross-tanked, the angles of heel at which capsizing would occur remain approximately the same, whether the crab tanks are empty or crossed.

19. It is concluded that all four crab tanks on ALTAIR were flooded, and that this not only caused a dramatic freeboard reduction, aggravating an already unstable condition, but also, by virtue of reduced buoyancy, resulted in ALTAIR's sinking after capsizing much more quickly than the AMERICUS did.

20. Although the time and location of ALTAIR's loss is unknown, it is felt ALTAIR capsized within a few hours after departure from Dutch Harbor, possibly before the AMERICUS got underway (six hours later). While ALTAIR is concluded to have been less stable and more heavily loaded than the AMERICUS, sea conditions were more moderate for ALTAIR than for AMERICUS. These calm conditions enabled ALTAIR's voyage beyond that point out of Dutch Harbor where the ALTAIR was sighted by the inbound SILVER WAVE.

21. The results of Phase 1 of the stability investigation, which incorporated the drag gear conversion and various crab tank flooding and fuel distribution scenarios, and Phase 2, which included an assumed weight gain in addition to the drag gear conversion, suggest it was the combination of the above named factors, and not the existence of any one by itself, that produced these casualties.

22. Had the AMERICUS and ALTAIR sailed with full double bottom tanks, and empty crab tanks, these casualties would not have occurred. To that end, improper loading is concluded to be the proximate cause of these casualties.

23. Though stability of the ALYESKA was not evaluated, it is concluded her stability characteristics were dangerously minimal due to her sailing with empty double bottoms and all crab tanks flooded. It appears the lighter fuel

and crab pot loads on ALYESKA, compared to the AMERICUS and ALTAIR, made the difference between survival and capsizing.

24. The IMO criteria published in NVC 3-76 provides an adequate margin of safety for fishing vessels. However, it is clear satisfying the initial GM criterion of 1.148 feet is the least important of that criteria and, to be meaningful, GM should be figured in terms of how Mr. Fisker-Andersen defines "required GM."

25. There is no evidence to indicate Dakota Creek Industries, either in construction or conversion of AMERICUS and ALTAIR, caused or contributed to the cause of these casualties.

26. There is no evidence to indicate Mr. Fisker-Andersen, either in design of or stability calculations for the AMERICUS and ALTAIR, caused or contributed to the cause of these casualties.

27. The AMERICUS and ALTAIR were well maintained vessels. There is no evidence to indicate the uninspected status of the vessels caused or contributed to the cause of these casualties.

28. There is convincing evidence that commercial fishermen in general lack an appreciation of principles of stability. This investigation demonstrated that there was a critical failure to utilize information (stability booklets) readily available for determining safe loading.

RECOMMENDATIONS

1. It is recommended that the Commandant republish Navigation and Vessel Inspection Circular (NVC) 3-76, reiterating the IMO criteria for Fishing Vessel Stability, and suggesting the following additional practices:

   a. Incline all newly constructed vessels, or incline the first of a class and then conduct deadweight surveys on the remaining vessels of the class.

   b. Follow policy stated in paragraph 55, Findings of Fact, regarding inclines or deadweight surveys for vessels modified.

   c. Re-evaluate, by incline or deadweight survey, lightship parameters of vessels periodically, particularly during the first few years of service (i.e., two years and five years after construction).

   d. Adopt a modified loadline system, based on the calculated waterline at common operating conditions, to visibly define minimum required freeboard.

   e. Emphasize strict adherence to stability letters and booklets.

2. It is recommended that the Commandant consider seeking authorization to promulgate minimum competency standards and require licenses for the masters of commercial fishing vessels of a minimum length and/or tonnage. These standards could be established by a cooperative effort involving the

Commandant's Fishing Vessel Safety Initiative Task Force, Fishing Vessel Safety Centers, and various local organizations of commercial fishermen. Meeting minimum competency standards could perhaps best be accommplished by documenting minimum required experience and successfully completing a Coast Guard approved course, or taking a Coast Guard prepared examination in lieu of the approved course.

3. The results of this investigation do not provide a basis for recommending fishing vessels be inspected by the Coast Guard. However, the potential of a non-regulatory method for upgrading industry practices exists in disseminating information, such as that which may arise from recommendations 1 and 2, to insurance companies which underwrite fishing vessels. Insurance companies, by imposing certain requirements or conditions upon which coverage is made available, are in a position to dramatically promote the cause of fishing vessel safety.

4. It is recommended that a copy of this report be forwarded to IMO.

5. It is recommended that this case be closed.

JOHN E. De CARTERET
CAPTAIN, U.S. COAST GUARD
Chairman

PAUL J. LARSON
LIEUTENANT COMMANDER, U.S. COAST GUARD
Member and Recorder

Encl: (1) COMDT (G-MMI-1/14) ltr 16732/AMERICUS OF 28 Feb 83 (Convening Order
(2) Record of Proceedings-Transcripts and Exhibits

APPENDIX A

INTERNATIONAL MARITIME ORGANIZATION (IMO)
STABILITY CRITERIA FOR FISHING VESSELS

1. IMO publishes criteria for the intact stability of fishing vessels in its Resolution A.168(ES.IV). These criteria consist of:

(a) Minimum initial GM of not less than 1.148 feet,

(b) a minimum area under the righting lever curve up to 30° of not less than 10.399 foot-degrees,

(c) a minimum area not less than 5.639 foot-degrees between the angles of heel of 30° and 40°, or the angle of flooding if less than 40°,

(d) a minimum area not less than 16.918 foot-degrees from 0° to 40°, or if the angle of flooding if this angle is less than 40°,

(e) the maximum righting arm should occur at an angle of heel preferably exceeding 30°, but not less than 25°, and

(f) the righting arm lever should be at least 0.656 feet at an angle of heel equal to or greater than 30°.

2. Dr. Tad Kowalski, Department of Ocean Engineering, College of Engineering, University of Rhode Island, who also serves as Chairman, National Fishing Vessel Safety Center Coordinating Committee, developed a "composite" IMO righting lever curve using the IMO criteria and the following rationale:

(a) The above IMO criteria has been consolidated into a single righting arm curve. This "composite" curve can serve as the boundary within which the righting arm curve of any fishing vessel may not cross if the vessel is to be considered stable. Due to the options presented by IMO, this curve is not absolutely true to all the above criteria. Where choices have to be made, the more conservative values are used. Thus, it is assured that a vessel whose righting arm curve's characteristics do not satisfy the IMO criteria will "clear" the composite curve. However, it is possible that a few vessels with unusually shaped righting arm curves might fail in comparison with the composite curve even though passing all the IMO criteria.

(b) The composite curve was constructed in the following way. First, the overall shape of the curve was held to maintain similarity with typical righting arm curves of fishing vessels. This curve is generally parabolic. The left side is flattened at initial angles creating an inflection point about half way up. The right side is quite full. The initial flat part was determined by the GM criterion. A straight line is drawn from 0° to 5° with GM as its slope. The height of the curve is determined by the height criterion of 0.656 feet and placed about 30°. The fullness of the curve between 5° and 30° is determined by the area criteria up to 30° and up to to 40°. The right side of the curve is then continued smoothly from 40° in a manner which maintains symmetry with typical curves. A copy of a typical righting arm curve is shown as Figure 1, Appendix A.

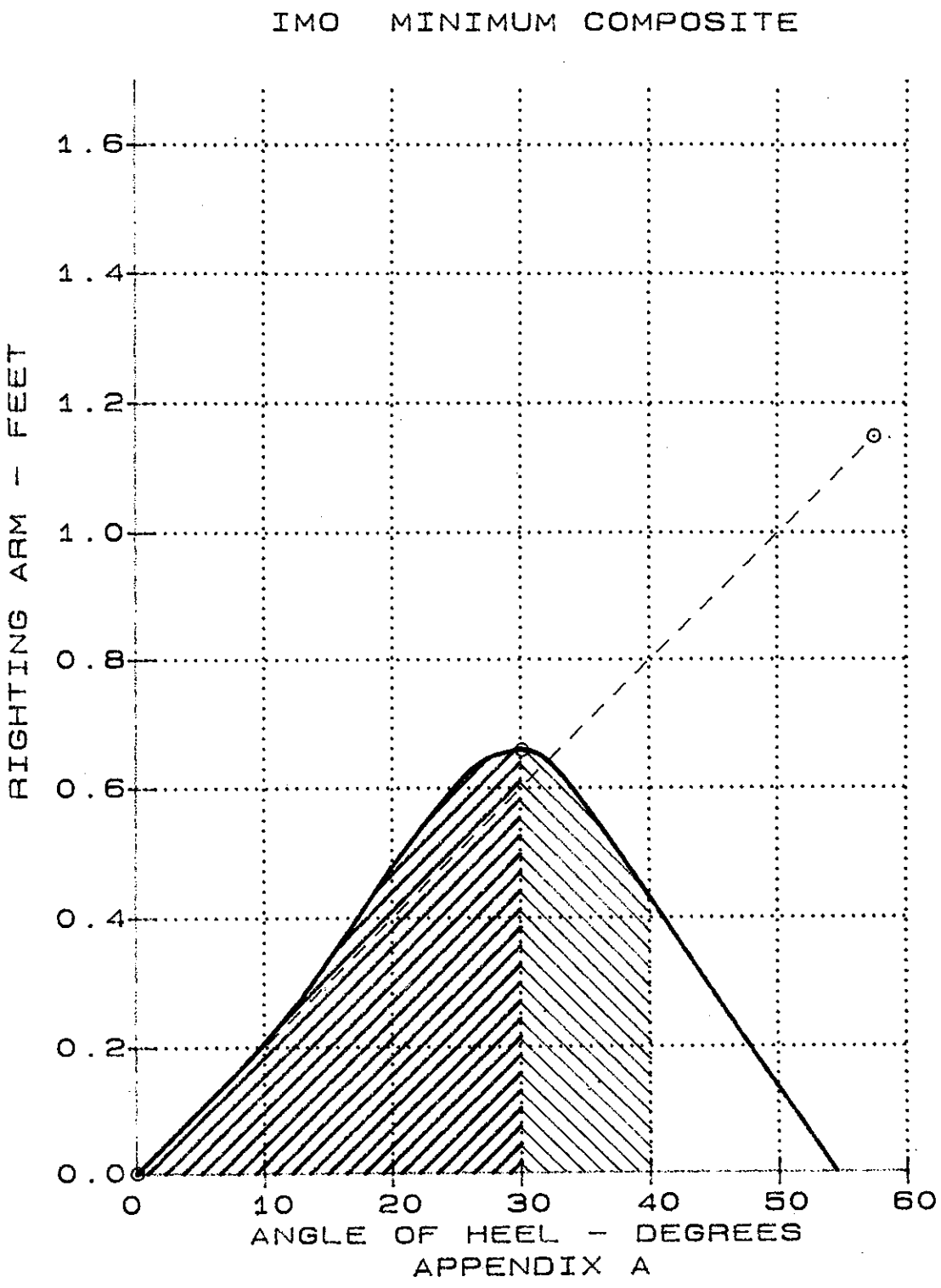

IMO MINIMUM COMPOSITE
RIGHTING ARM - FEET
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
ANGLE OF HEEL - DEGREES
APPENDIX A

FIGURE 1