



UNITED STATES COAST GUARD

FORMAL INVESTIGATION INTO THE CIRCUMSTANCES
SURROUNDING THE ALLISION OF THE
T/V EAGLE OTOME
WITH THE
M/V GULL ARROW
AND SUBSEQUENT COLLISION WITH THE
T/B KIRBY 30406
PUSHED BY
UTV DIXIE VENGEANCE
AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON
JANUARY 23, 2010.





16732

APR 30 2013

**ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND
SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE
VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON
JANUARY 23, 2010**

ACTION BY THE COMMANDANT

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

COMMENTS ON CONCLUSIONS

Conclusion 8: There are indications that fatigue from untreated [REDACTED] and work schedule impaired the first pilot's ability to respond adequately to the vessel's transit, accurately assess the increasing risk of collision and the increasing severity of the sheering and take alternate actions, and handle multiple tasks. The degree of the contribution of fatigue to the cause of the casualty and the poor decision making on the part of the first pilot is unknown.

Comment: I partially concur with this conclusion

There is an abundance of research which defines the factors which result in fatigue. In particular, the Coast Guard publication "[Crew Endurance Management Practices - A Guide for Maritime Operations](#)" provides an overview of the various factors which affect human performance and contribute to fatigue, as well as a method for managing these risk factors. Based on this body of work and the evidence presented in this report regarding the First Pilot's work schedule, his lack of sleep in the 48 hours prior to the incident, his prescribed medications, and his [REDACTED] condition, I agree that it is likely that he was fatigued at the time of the incident while directing the movement of the EAGLE OTOME.

However, I do not believe there is sufficient evidence to support the assertion that fatigue impaired the First Pilot's abilities to assess the situation and act accordingly. Specifically, there is no evidence on the record which documents any behaviors or actions of the First Pilot which would lead me to believe that fatigue impaired the First Pilot's ability to act and react in this situation. Furthermore, the conversations recorded by the Voyage Data Recorder indicate the First Pilot was coherent and attentive in the minutes leading up to the initiating event, as well as during the subsequent events leading up to the allision with the GULL ARROW.

Conclusion 12: The master of the DIXIE VENGEANCE failed to slow when he first recognized a risk of collision. This error cost as much as seven seconds of astern propulsion. Once full astern was applied on DIXIE VENGEANCE slowed 2.3 knots in 1 minute. While the collision would not have been avoided with this action alone, there may have been sufficiently less energy

in the collision that the cargo tank of the EAGLE OTOME may not have been breached by tank barge KIRBY 30406.

Comment: I do not concur with conclusion 12.

There is no evidence which would support the assertion that an additional seven seconds of astern propulsion would have mitigated the damage to the vessels involved. In addition, the vessels had a mutually agreed upon passing arrangement. And given the tight confines of the channel and the lack of warning from the First Pilot regarding the loss of vessel control, the Master of the DIXIE VENGEANCE took appropriate action in maintaining his course and speed.

Conclusion: In addition to my comments on Conclusions 8 and 12, I also conclude that there is evidence of negligence on the part of the First Pilot, which contributed to the EAGLE OTOME's collision with the GULL ARROW, the subsequent collision with Barge 30406, and the release of oil into the Sabine-Neches Waterway. In particular, the First Pilot failed to adequately monitor the position of the vessel during the execution of the turn at Missouri Bend which in turn placed the vessel in a position to shear. Furthermore, following the first shearing event the First Pilot failed to take positive and ample action to manage the meeting situation with the tug DIXIE VENGEANCE.

ACTION ON RECOMMENDATIONS

There were 16 recommendations made by the Lead Investigator. In my response, the recommendations have been grouped by the name of the party or entity to whom it is addressed.

United States Coast Guard Recommendations 7, 8 and 9

Recommendation 7: That the Coast Guard pursue regulations to require mariners to notify the Coast Guard National Maritime Center when they have a change in their medical condition, even if they are not currently operating under a medical waiver, so that an evaluation can be made of their fitness to serve under their license.

Action: I partially concur with this recommendation and provide an alternate course of action.

I agree that there are circumstances when a change in a mariner's medical condition must be evaluated by medical personnel to ensure the condition does not pose an inordinate risk of sudden incapacitation or debilitating complication, or require medication that impairs judgment or reaction time. Currently, medical waiver letters from National Maritime Center state that, "waivers become invalid if symptoms develop attributable to the condition which interferes with duties". In addition, mariners are directed to report changes in medical condition to the Coast Guard within 30 days. Barring significant changes to the current regulations, I believe this is a reasonable approach to ensure mariner's engage with NMC to address changes in waived medical conditions.

With respect to the general mariner population, there is currently no requirement for all mariners to report changes in medical conditions. While such a requirement may help to ensure mariners

are able to perform their duties, it is important to recognize that the Coast Guard, in particular, the National Maritime Center has limited opportunity for intervention as current regulations only apply during application for and renewal of merchant mariner credentials. As such, I do not concur with the proposed recommendation as it would require significant changes to existing laws and regulations, and may not be the most feasible way to solve this problem. In lieu of the proposed recommendation, I direct the National Maritime Center and the Office of Compliance to discuss this issue with other stakeholders via the Merchant Mariner Personnel Advisory Committee.

Recommendation 8: That the Coast Guard National Maritime Center amend their administrative procedures to receive signed receipts for medical waivers prior to forwarding to a mariner, the license or document covered by that waiver, and apply expiration dates to medical waivers for pilots to ensure they receive and maintain the most current waiver applicable to the license under which they are operating.

Action: I concur with the intent of this recommendation, and recognize that the National Maritime Center is already taking steps to implement this recommendation.

I agree that it is important for mariners to acknowledge and understand their medical waivers along with the operating restrictions placed on them, as well as keep the Coast Guard informed of any changes in waived medical conditions.

Currently, the National Maritime Center mails merchant mariner credentials and medical waivers to mariners simultaneously. Upon receipt of the credential and waiver, mariners are directed by the NMC to return a signed copy of the waiver. In addition, the NMC has advised mariners that failure to return a signed copy of the waiver may result in administrative action against their credentials. While additional administrative measures may enhance the current process, the cost of implementing such measures as well as analysis of other viable alternatives for achieving compliance must be considered. As such, I direct the National Maritime Center to review this recommendation and develop procedures to more closely monitor medical waivers.

With respect to the recommendation to apply expiration dates on medical waivers for pilots, I concur with the intent of the recommendation. However, I believe that the current requirement for pilots to submit an annual physical examination is sufficient to ensure that medical waivers for pilots are current, and periodically checked for adequacy. As such, no further action will be taken on this recommendation as it applies to pilots.

Recommendation 9: That the Coast Guard explore adding a requirement of an evaluation of mariners for sleep apnea to mariner quintennial physicals, and for pilots, each physical associated with their license application or renewal.

Action: I concur with this recommendation, and recognize that the National Maritime Center is already taking steps to implement this recommendation.

I agree that sleep apnea is a serious condition which may affect the performance of mariners if not properly treated. Sleep apnea is listed on the Merchant Mariner Credential Medical Evaluation Report (Form CG-719K) among specific conditions that must be evaluated and

reported by the mariner's physician. In addition, the current screening and evaluation practices of the National Maritime Center ensures that a mariner with untreated sleep apnea is properly evaluated and not given a waiver and/or issued a credential if their medical condition presents a significant risk to marine safety. As such, I believe the intent of this recommendation is being met by current requirements and practices, and no further action will be taken on this recommendation.

**Jefferson and Orange County Board of Pilot Commissioners
Recommendations 1, 2 and 5**

Recommendation 1: That the Jefferson and Orange County Board of Pilot Commissioners (referred to as the "the Board") undertake a review of reportable marine casualties involving Sabine Pilots and commission a third party audit of the pilot training program and advanced pilot training and enact changes to ensure all Sabine Pilots have sufficient training, guidance and practice in shiphandling, communications, and emergency shiphandling skills in narrow waterways such as the Sabine-Neches Waterway

Action: I concur with the intent of this recommendation and provide an alternative course of action.

The Coast Guard investigates marine casualties to determine the cause of the casualty and make recommendations to improve the laws and regulations which promote marine safety. Above and beyond the improvement of regulations, the Coast Guard also uses the information contained in investigative reports to engage in a dialogue with operators and other waterways stakeholders for the same purpose. Therefore, I direct the local Captain of the Port (COTP) to provide a copy of this report of investigation to the Board. Furthermore, I direct the local COTP to discuss the issue of pilot training with the Board and to ensure this recommendation is considered.

Recommendation 2: That the Jefferson and Orange County Board of Pilot Commissioners require pilots to use the name of the ship in accordance with 47 CFR 80.331, and locations listed on navigation charts, in bridge-to-bridge communications.

Action: I concur with this recommendation. Communication between vessels is key to the safe and efficient operation of any waterway or vessel. Furthermore, communication between a pilot and the bridge crews of other vessels is a vital element to safe navigation. As such, the lexicon of the waterway and communications protocols should be clear, consistent and in accordance with the regulations in 47 CFR 80.331. Furthermore, local pilot rules and practices should bolster the regulations. As the enforcement of these regulations governing communication lies clearly with the Coast Guard and the Captain of the Port, it is imperative that the COTP enforce these regulations accordingly and utilize opportunities such as this incident, to highlight the need for proper communications with the various waterways stakeholders.

I agree that the poor interaction and communications between the First Pilot onboard the EAGLE OTOME and the master of the tug DIXIE VENGEANCE contributed to this casualty. As such, I direct the local Captain of the Port to provide a copy of the report of investigation to the Board. In addition, I direct the local Captain of the Port to discuss the issue of communications protocols with the Board and to ensure this recommendation is considered.

APR 30 2013

Recommendation 5: That the Jefferson and Orange County Board of Pilot Commissioners establish continuing education requirements for Sabine Pilots to include Bridge Resource Management on a five year interval.

Action: I concur with the intent of this recommendation and provide an alternative course of action.

I agree that the First Pilot should have engaged the Second Pilot, the Master and bridge crew of the EAGLE OTOME to help manage the voyage, in particular, the meeting situation with the tug DIXIE VENGEANCE. In addition, I agree that Bridge Resource Management (BRM) training would reinforce the need to use all available bridge resources, especially during transits which require precise maneuvering and the careful coordination of movement between vessels. Therefore, I direct the local Captain of the Port to provide a copy of this report of investigation to the Board. In addition, I direct the local Captain of the Port to discuss the issue of pilot training and BRM with the Board and to ensure this recommendation is considered.

With respect to the Eighth District Commander's alternative recommendation to expand the requirement for additional BRM training to all pilots nationwide, I would agree that requiring BRM training on recurring basis would be in the best interests of marine safety. As such, I direct the Office of Vessel Activities, the Office of Waterways and Ocean Policy and the Office of Operating and Environmental Standards to consider this recommendation for future implementation.

**South East Texas Waterway Advisory Council (SETWAC)
Recommendations 3, 12 and 13**

Recommendation 3: That the South East Texas Waterway Advisory Council (SETWAC), with the Port Arthur VTS, develop a consensus agreement that ship names and charted locations be used in communications in the Sabine Neches Waterway.

Action: I concur with the intent of this recommendation and provide an alternative course of action.

Consistent with my rationale for support of recommendation 2, I agree that local rules and practices should promote clear and consistent communications amongst all waterways users. As the SETWAC provides a mechanism for discussing a wide variety of issues relevant to all waterways stakeholders, I direct the local Captain of the Port provide a copy of this report of investigation to the SETWAC. In addition, I direct the local Captain of the Port to work within SETWAC to discuss the report and this recommendation, as well as, any ideas to improve communications.

Recommendation 12: That the SETWAC establish consensus, risk based criteria for the use of escort tugs for loaded deep draft vessels for the Sabine-Neches Waterway, in particular the 12 mile portion shared by the Sabine Ship Channel and the Gulf Intracoastal Waterway.

Action: I concur with the intent of this recommendation, and provide an alternative course of action.

I agree that risk-based criteria which would support a master's or pilot's decision to use escort tugs may facilitate safe vessel movement in the Sabine-Neches waterway. As such, I direct the local Captain of the Port to provide a copy of the report of investigation to the SETWAC. In addition, I direct the local Captain of the Port to work within SETWAC to discuss the risks posed by loaded, deep draft vessels in the Sabine-Neches waterway, as well as any ideas or strategies to manage those risks.

Recommendation 13: That SETWAC, with the Army Corps of Engineers explore the costs and benefits of changes to the waterway to allow for more room for the navigation of deep draft vessel traffic and barges, that may include widening the channel or creating a barge shelf along the 12 miles of the Sabine-Neches Waterway shared by the Sabine Ship Channel and the Gulf Intracoastal Waterway to reduce the risk of ships colliding with tows.

Action: I concur with the intent of this recommendation, and provide an alternative course of action.

I agree that waterway improvements such as widening of the channel may facilitate safe vessel movement in the Sabine-Neches waterway. As such, I direct the local Captain of the Port to provide a copy of the report of investigation to the SETWAC. In addition, I direct the local Captain of the Port to work within SETWAC to discuss the risks posed by loaded, deep draft vessels in the Sabine-Neches waterway, as well as any ideas or strategies to manage those risks.

The American Pilots Association Recommendations 4, 6, and 16

Recommendation 4: That the American Pilots Association encourage member associations to establish communications best practices that emphasize the use of vessel names and charted locations in bridge to bridge communications.

Recommendation 6: That the American Pilots Association educate their members on the effects of untreated sleep apnea on fatigue and cognitive ability, and the general effects of rotating day and night shift schedules on pilot fatigue and human performance.

Action (4 & 6): I concur with the intent of recommendations 4 and 6, and provide an alternative course of action.

The American Pilots' Association (APA) represents the interest of virtually all state pilots in the United States, as well as three groups of U.S. registered pilots operating on the Great Lakes. Therefore, the APA is in a position to discuss issues which are of concern to all pilots and influence their membership to adopt practices which promote marine safety. With this in mind, I will address recommendations 4 and 6 simultaneously as these issues of concern maybe applicable to all pilots.

I agree that under utilization of the bridge team and poor communications between the First Pilot and the bridge crew contributed to this casualty. While I may not agree that fatigue contributed to this casualty and do not believe there is sufficient evidence to support that assertion, the findings of the investigator with respect to the First Pilot's health, medications and work schedule are still of great concern to the Coast Guard. As such, I direct the Office of Investigations to provide a copy of this report of investigation to the APA. In addition, I direct the appropriate Coast Guard headquarters staffs to discuss this casualty with the APA and to ensure that recommendations 4 and 6 are considered.

Recommendation 16: That the American Pilots Association (APA) engage with their members and explore best practices for placing pilots on an administrative status that permits an evaluation of the pilot for mental and physical fitness to pilot ships, by an appropriate authority, prior to returning to pilot duties.

Action: I concur with the intent of recommendation 16, and provide an alternative course of action.

I agree that, in certain cases, pilots directly involved in a serious marine casualty should be evaluated prior to returning to work. Therefore, I direct the Office of Investigations to commence a dialogue with APA on how best to address this recommendation.

The Sabine Pilots Association Recommendations 10, 11 and 15

Recommendation 10: That the Sabine Pilots Association revisit the guidelines on two pilot transits and delineate roles and responsibilities between the two pilots that would serve to afford the masters of piloted ships the benefit of the expertise of two Sabine Pilots on the bridge instead of one pilot at a time at various times in the transit.

Recommendation 11: That the Sabine Pilots Association provide to vessel masters, any applicable protocols and guidelines related to two pilot transits.

Action (10 & 11): I concur with the intent of recommendations 10 and 11 and provide an alternative course of action.

I agree that in "two pilot" transits there may be times and circumstances which require both pilots to be actively engaged in the navigation of the vessel. I also agree that the roles and responsibilities of each pilot aboard for a "two pilot" transit should be clearly defined and communicated to those utilizing the pilot services. Therefore, I direct the local Captain of the Port to provide a copy of this report of investigation to the Sabine Pilot's Association. In addition, I direct the local Captain of the Port to discuss this recommendation with the Sabine Pilot's Association to ensure the recommendation is considered.

Recommendation 15: That the Sabine Pilots Association develop and implement administrative and dispatch procedures that would remove a pilot involved in a serious marine incident from the board of pilots on watch until an evaluation of mental and physical fitness to pilot is completed by the Jefferson and Orange County Board of Pilot Commissioners or other appropriate entity

APR 30 2013

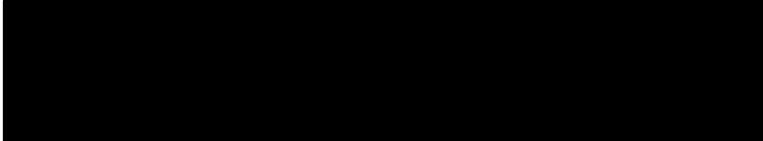
Action: I concur with the intent of this recommendation and provide an alternative course of action.

I agree that, in certain cases, pilots and mariners directly involved in a serious casualty should be evaluated prior to returning to work. In addition to the course of action provided in Recommendation 16, I also direct the local Captain of the Port to engage the Sabine Pilots Association and the Jefferson and Orange County Board of Pilot Commissioners to discuss this concern and address this recommendation within their own authority.

AET, Limited

Recommendation 14: That AET, Limited, owner and operator of the EAGLE OTOME, review this casualty and emphasize the importance of Bridge Resource Management with their mariners and navigation watch personnel.

Action: I concur with this recommendation. A copy of this report of investigation will be forwarded to AET, Limited for their consideration.



JOSEPH A. SERVIDIO
Rear Admiral, U. S. Coast Guard
Assistant Commandant for Prevention Policy

16732
DEC 16 2010

FIRST ENDORSEMENT on Investigating Officer's Memo 16732 of 19 May 2010

From: M.E. LANDRY, RADM
CCGD EIGHT

To: COMDT (CG-545)
Thru: CG LANTAREA (A-3P)

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW
AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY
THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES
WATERWAY ON 23 JANUARY 2010.

1. Forwarded, recommending approval. I concur with the Investigating Officer's findings of fact and conclusions, with the following amplifying comments and exceptions:
 - a. As it relates to conclusion #8, it should be noted that a medical doctor or other recognized subject matter expert would be needed to make a definitive evaluation or assessment of the first pilot's physical or mental condition at the time of the incident. It is equally important to note that none of the Coast Guard members assigned to the investigative team possess the requisite medical expertise to make such determinations.
 - b. I do not concur with conclusion #12 for the following reason: Although the master of the towing vessel DIXIE VENGEANCE made passing arrangements with the pilot onboard the EAGLE OTOME, he was not notified via radio that the EAGLE OTOME was in extremis when the vessel was first observed, and given the circumstance, could not have reasonably determined such. As such, the master of the DIXIE VENGEANCE was not required to slow his vessel.
2. I concur with the Investigating Officer's findings of safety recommendations, with the following amplifying comments and exceptions:
 - a. Safety Recommendation #1: That the Jefferson and Orange County Board of Pilot Commissioners undertake a review of reportable marine casualties involving Sabine Pilots and commission a third party audit of the pilot training program and advanced pilot training and enact changes to ensure all Sabine Pilots have sufficient training, guidance and practice in ship handling, communications, and emergency ship handling skill in narrow waterways such as the Sabine-Neches Waterway.

SUBJ: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW
AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY
THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES
WATERWAY ON JANUARY 23, 2010

16732

DEC 16 2010

I partially concur with safety recommendation #1 for the following reason: The recommendation is beyond the scope of Coast Guard regulatory authority. Alternative recommendation: forward a letter to cognizant pilot association for review and consideration.

- b. Safety Recommendation #2: That the Jefferson and Orange County Board of Pilot Commissioners require pilots to use the name of the ship in accordance with 47 CFR 80.331, and location listed on navigation charts, in bridge-to-bridge communications.

I do not concur with safety recommendation #2 for the following reason: The recommendation is already a requirement as codified by 47 CFR 80.331.

- c. Safety Recommendation #3: That the South East Texas Waterway Advisory Council (SETWAC), with the Port Arthur VTS, develop a consensus agreement that ship names and charted locations be used in communications in the Sabine Neches Waterway.

I do not concur with safety recommendation #3 for the following reason: The recommendation is already a requirement as codified by 47 CFR 80.331.

- d. Safety Recommendation #4: That the American Pilots Association encourage member associations to establish communications best practices that emphasize the use of vessel names and charted locations in bridge to bridge communications.

I do not concur with safety recommendation #4 for the following reason: The recommendation is not within the scope of Coast Guard jurisdiction, is not complete, and the intent of the recommendation is already a requirement as per 47 CFR 80.331.

- e. Safety Recommendation #5: That the Jefferson and Orange County Board of Pilot Commissioners establish continuing education requirements for Sabine Pilots to include Bridge Resource Management on a five year interval.

I partially concur with safety recommendation #5 for the following reason: This recommendation is a valid one that would benefit not only the Sabine Pilots, but pilots nationwide. The Jefferson and Orange County Board of Pilot Commissioners is not a regulatory body, and as such, they are not in a position to establish education requirements for Sabine Pilots or any other pilots. If this recommendation is expanded to include pilots nationwide a national entity is needed for implementation and enforcement authorities. Recommend this be passed to the National Maritime Center for review and possible incorporation in the license renewal process.

SUBJ: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW
AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY
THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES
WATERWAY ON JANUARY 23, 2010

16732

DEC 16 2010

- f. Safety Recommendation #6: That the American Pilots Association educate their members on the effects of untreated sleep apnea on fatigue and cognitive ability, and the general effects of rotating day and night shift schedules on pilot fatigue and human performance.

I partially concur with safety recommendation #6 for the following reasons: The American Pilots Association is not a regulatory body; it is a national trade association of professional maritime pilots. As such, it is not in a position to provide training to its member groups. Also, no specific conclusion supported by factual evidence points to fatigue as anything more than a possible contributory factor in this ROI. However, fatigue can be a serious problem to mariner safety and information on the subject such as the International Maritime Organization's publication, "Guidelines on Fatigue", should be recommended to the American Pilots Association as information to provide to members.

- g. Safety Recommendation #7: That the Coast Guard pursue regulations to require mariners to notify the Coast Guard National Maritime Center when they have a change in their medical condition, even if they are not currently operating under a medical waiver, so that an evaluation can be made of their fitness to serve under their license.

I partially concur with safety recommendation #7 for the following reason: This recommendation addresses a need that is present in the evaluation of the fitness of licensed mariners, but it requires clarification. As per 46 CFR 11.709: any individual who pilots a vessel of 1,600 GT and over must have a thorough physical exam each year and each first class pilot must provide the Coast Guard with a copy of their most recent physical exam. There is nothing, however, in the CFR that requires mariners to inform the Coast Guard of changes to medical conditions whether as a pilot or general mariner (unless there are changes in condition related to an already issued waiver). A change in medical condition could greatly affect the fitness of a mariner and how they are able to perform the functions they are licensed to perform. If the Coast Guard is not aware of changes, a mariner could be operating with a license that is not suitable for their condition. This recommendation addresses a valid need, but it is worded very generally and requires amplification. For example, it recommends that "mariners" notify the Coast Guard. That could be narrowed down to pilots or mariners holding a specific license. Also it states: "a change in their medical condition". This is too broad; "change" and "medical condition" need to be defined.

- h. Safety Recommendation #8: That the Coast Guard National Maritime Center amends their administrative procedures to receive signed receipts for medical waivers prior to forwarding to a mariner, the license or document covered by that waiver, and apply expiration dates to medical waivers for pilots to ensure they

SUBJ: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW
AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY
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WATERWAY ON JANUARY 23, 2010

16732

DEC 16 2010

receive and maintain the most current waiver applicable to the license under which they are operating.

I partially concur with safety recommendation #8 for the following reason: There are measures already in place to satisfy this recommendation. Unfortunately they were not followed in this case. The medical portion of mariner licensing involves several parties (the applicant, the examining official and the Coast Guard) that must all participate and provide full disclosure to make this system function properly. Instead of changing or adding to the system that is already in place and adequate, I think the Coast Guard needs to be more diligent in keeping up with medical waivers and conditions, and licensed mariners must disclose all medical conditions to the Coast Guard.

- i. Safety Recommendation #9: That the Coast Guard explore adding a requirement of an evaluation of mariners for sleep apnea to mariner quintennial physicals, and for pilots, each physical associated with their license application or renewal.

I do not concur with safety recommendation #9 for the following reason: The recommended action is already being met by 46 CFR 10.215 (d) and NVIC 04-08.

- j. Safety Recommendation #10: That the Sabine Pilots Association revisit the guidelines on two pilot transits and delineate roles and responsibilities between the two pilots that would serve to afford the masters of piloted ships the benefit of the expertise of two Sabine Pilots on the bridge instead of one pilot at a time at various time in the transit.

I partially concur with safety recommendation #10 for the following reason: This is a valid recommendation, but one that is outside the scope of Coast Guard jurisdiction. Alternate recommendation: forward a copy of this recommendation to the Sabine Pilots Association.

- k. Safety Recommendation #11: That the Sabine Pilots Association provide to vessels masters, any applicable protocols and guidelines related to two pilot transits.

I do not concur with safety recommendation #11 for the following reason: This recommendation has already been addressed in safety recommendation #10 and is not within Coast Guard jurisdiction.

- l. Safety Recommendation #12: That SETWAC establish consensus, risk based criteria for the use of escort tugs for loaded deep draft vessels for the Sabine-Neches Waterway, in particular the 12 mile portion shared by the Sabine Ship Channel and the Gulf Intracoastal Waterway.

SUBJ: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW
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WATERWAY ON JANUARY 23, 2010

16732

DEC 16 2010

I partially concur with safety recommendation #12 for the following reason:
SETWAC is not a regulatory body. Alternate recommendation: forward this
recommendation as a possible discussion point for SETWAC.

- m. Safety Recommendation #13: That SEWTAC, with the Army Corps of Engineers, explore the costs and benefits of changes to the waterway to allow for more room for the navigation of deep draft vessel traffic and barges, that may include widening the channel or creating a barge shelf along the 12 miles of the Sabine-Neches Waterway shared by the Sabine Ship Channel and the Gulf Intracoastal Waterway to reduce the risk of ships colliding with tows.

I partially concur with safety recommendation #13 for the following reason:
SETWAC is not a regulatory body. Alternate recommendation: forward this
recommendation as a possible discussion point for SETWAC.

- n. Safety Recommendation #14: That AET, LTD, owner and operator of the EAGLE OTOME, review this casualty and emphasize the importance of bridge Resource Management with their mariners and navigation watch personnel.

I concur with safety recommendation #14 for the following reason: AET, LTD would benefit from receiving a copy of this report and reviewing all pertinent recommendations with employees.

- o. Safety Recommendation #15: That the Sabine Pilots Association develop and implement administrative and dispatch procedures that would remove a pilot involved in a serious marine incident from the board of pilots on watch until an evaluation of mental and physical fitness to pilot is completed by the Jefferson and Orange County Board of Pilot Commissioners or other appropriate entity.

I partially concur with safety recommendation #15 for the following reason: The Coast Guard has no regulatory authority over the Sabine Pilots Association or Jefferson and Orange County Board of Pilot Commissioners, and as such, cannot direct them to develop or implement any procedures. Alternate recommendation: forward to the Sabine Pilots Association and the Jefferson and Orange County Board of Pilot Commissioners for their review.

- p. Safety Recommendation #16: That the American Pilots Association engage with their members and explore best practices for placing pilots on an administrative status that permits an evaluation of the pilot for mental and physical fitness to pilot ships, by an appropriate authority, prior to returning to pilot duties.

I partially concur with safety recommendation #16 for the following reason: The Coast Guard has no regulatory authority over the American Pilots Association, and as such, cannot direct them to develop or implement any procedures.

SUBJ: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW
AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY
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WATERWAY ON JANUARY 23, 2010

16732

DEC 16 2010

Alternate recommendation: forward to the American Pilots Association for their
review.

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MEMORANDUM

16732

19 May 2010

From: [REDACTED]
CDR Kathleen Moore, USCG
Lead Investigating Officer

To: Commander, Eighth Coast Guard District (dpi)

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND
SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV
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ON JANUARY 23, 2010

Ref: (a) Letter of Designation as Investigating Officer, dated January 26, 2010
(b) Marine Safety Manual, Volume V; COMDTINST M16000.10A
(c) Memorandum of Understanding between NTSB and USCG signed 19 Dec 2008
(d) IMO Casualty Investigation Code, 2008

Preliminary Statement

1. Reference (a) is the designation to conduct a formal investigation into the allision of the Tank Vessel (T/V) EAGLE OTOME with the Motor Vessel (M/V) GULL ARROW, berthed at the Port of Port Arthur, and subsequent collision of the T/V EAGLE OTOME with the Tank Barge (T/B) KIRBY 30406, the first of two loaded tank barges pushed by the tug DIXIE VENGEANCE. The EAGLE OTOME then went aground at the stern with the tank barge lodged in the No. 1 Starboard Ballast Tank, puncturing the No. 1 Cargo Tank. The incident occurred on January 23, 2010 and resulted in an oil spill of over 460,000 gallons from the tank ship into the Sabine-Neches Waterway.

2. Post Incident Risk Management. The lack of oversight by Jefferson and Orange County Board of Pilot Commissioners and the Sabine Pilots Association of the day to day function of the individual pilots created a condition where a pilot who experienced a major marine casualty could be allowed to continue to pilot vessels without any evaluation of his or her fitness. This condition constitutes a lack of any assessment to ensure a pilot is fit to continue to pilot ships and represents an increased risk to the waterway of a subsequent incident. The condition was discovered during the course of the investigation and although not contributory to the incident being investigated, it is being brought forward here so that due consideration may be given to reduce the risk of future casualties where this could condition could be a causative factor or pre-condition.

3. This formal investigation was conducted according to the policies outlined in Reference (b), including the convening of a public hearing and the designation of parties in interest as part of the formal proceedings. MSTC [REDACTED] and LTJG [REDACTED] were assigned to assist. With the investigative assistance of LTJG [REDACTED] Mr. [REDACTED] MSTI [REDACTED] the Investigations Division of Marine Safety Unit Port Arthur, and others, the team conducted numerous interviews and completed a public hearing in Port Arthur, Texas. In accordance with reference (b) the team was able to gather facts, conduct analysis, draw conclusions and make recommendations regarding this incident. National Transportation Safety Board investigators [REDACTED], [REDACTED] and [REDACTED] participated in the investigation in accordance

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

with reference (c) and NTSB will complete an independent report. The casualty was also investigated in accordance with reference (d) and Singapore has been designated a substantially interested state. All times listed in this Report of Investigation are Central Standard Time and based on a 24 hour clock. The MISLE Activity number is 3668653.



Figure 1: EAGLE OTOME with KIRBY 30406 in the starboard bow.



Figure 2: Closer view of post collision positions of EAGLE OTOME, KIRBY 30406 and GULL ARROW. Also visible is the damage to the GULL ARROW on the hull at the juncture of the deck with the house (white superstructure).

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

Executive Summary

On January 23, 2010, the loaded tankship EAGLE OTOME was transiting from anchorage to the Beaumont Exxon Mobile Terminal, with two Sabine Pilots aboard. The vessel had departed anchorage at approximately 0530 and was inbound in the Sabine-Neches Waterway. The two pilots each directed the vessel's movement at different points in the transit. At approximately 0900, the first pilot¹ relieved the second pilot², and had the conn. The master, third officer, an able-bodied seaman (AB) and a cadet were on the bridge as the navigation watch. The third officer was on the engine order telegraph, the AB was on the helm and the cadet alternated between lookout and plotting on a paper chart. The second pilot remained on the bridge. The weather was clear with low clouds. There was a 7 to 10 knot southeasterly breeze and a flood current of less than one knot. The vessel was transiting at between 6 and 8 knots inbound toward Beaumont.

At approximately 0923, the master of the DIXIE VENGEANCE made a security call as the vessel transited down bound and entered the Southern Sector of the Port Arthur Vessel Traffic Area in the vicinity of a location known as Schoolhouse³. The first pilot on the EAGLE OTOME responded to the security call and the two vessels made a port to port passing agreement. Each expected to meet in the vicinity of the Port of Port Arthur, north of the Martin Luther King (MLK) Bridge. At that time, the EAGLE OTOME was inbound, just above Texas Island Intersection. Upon exiting Missouri Bend, at approximately 0924, in the vicinity of the MLK Bridge, the vessel was affected by bank suction on the west, or "green" side, of the channel and experienced the first of four sheers between the sides of the channel. The first pilot used helm commands and increased the engine speed from slow ahead to half ahead with no effect. The tankship continued to sheer to the red side of the channel and then toward the green side as it passed beneath the bridge. Once the EAGLE OTOME was above the bridge, the ship sheered again toward the red side of the channel and then back toward the green side. The first pilot ordered full ahead and about 10 seconds later ordered to let go starboard anchor. During the fourth and final sheer to port, the bow of EAGLE OTOME was crossing the centerline of the channel. At approximately 0934, the first pilot ordered full astern. The master had replaced the third mate at the engine order telegraph and hit the emergency stop by mistake. Following a call from the engine room the engine order telegraph was set to half astern. The crew of the EAGLE OTOME then released the starboard anchor and the first pilot sounded the danger signal. The master of the DIXIE VENGEANCE set his engines to full astern and sounded the general alarm and the danger signal. At approximately 0935 the EAGLE OTOME struck the starboard side of the M/V GULL ARROW, berthed at the Port of Port Arthur. Seconds later, the EAGLE OTOME and KIRBY 30406 collided. KIRBY 30406 was the first of the two loaded barges being pushed by the DIXIE VENGEANCE. The bow of the barge penetrated the No. 1 starboard ballast tank and the No. 1 cargo tank of the EAGLE OTOME and became lodged in the sideshell of the tankship. Oil from the No. 1 cargo tank spilled into the Sabine-Neches Waterway.

¹ Sabine Pilots are assigned unit numbers. Throughout this report, the first pilot refers to Sabine Pilot Unit 25.

² Throughout this report, the second pilot refers to Sabine Pilot Unit 10.

³ The Schoolhouse is indicated on the chart as an unnamed cupola and is at Gulf Intracoastal Waterway Mile Marker 185. The Sabine-Neches ship channel does not have mile markers. Locations are described with respect to charted landmarks wherever possible.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

The master of the DIXIE VENGEANCE, the first pilot of the EAGLE OTOME and the master of the EAGLE OTOME immediately made notifications to the Coast Guard Marine Safety Unit Port Arthur, the National Response Center and Port Arthur Vessel Traffic Service (VTS). The port coupling between the two barges broke just after the impact and the master of the DIXIE VENGEANCE maneuvered to keep the tow together. At this time, the first pilot of the EAGLE OTOME gave engine and helm orders to move the bow of the EAGLE OTOME away from the GULL ARROW to prevent further impacts, and the stern of the EAGLE OTOME went aground on the red side of the channel. Approximately 460,000 gallons of oil from the No. 1 Cargo tank entered the Sabine-Neches Waterway, and the channel was closed to vessel traffic for four days. At approximately 2330, the barge KIRBY 30406 floated free from the EAGLE OTOME and the flotilla of KIRBY 30406, KIRBY 28112 and DIXIE VENGEANCE, damaged lighted buoy 52A.

Vessel Data

EAGLE OTOME	
Flag:	Singapore
IMO Number:	9051351
Call Sign:	S6FM
Service:	Oil Tanker
Classification Society:	American Bureau of Shipping
Keel Laid:	1993
Gross Tons:	52,504
Net Tons:	28,208
Deadweight Tons:	95,663 MT
Length (LOA):	809.7 ft
Breadth:	139 ft
Depth:	64 ft
Propulsion:	Diesel Direct
Horsepower:	16600
Owner:	American Eagle Tankers, Inc. LTD
Operator:	American Eagle Tankers, Inc. LTD
Charterer:	Standard Tankers Bahamas, LTD
Cargo Capacity 100%:	693,911 bbls

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

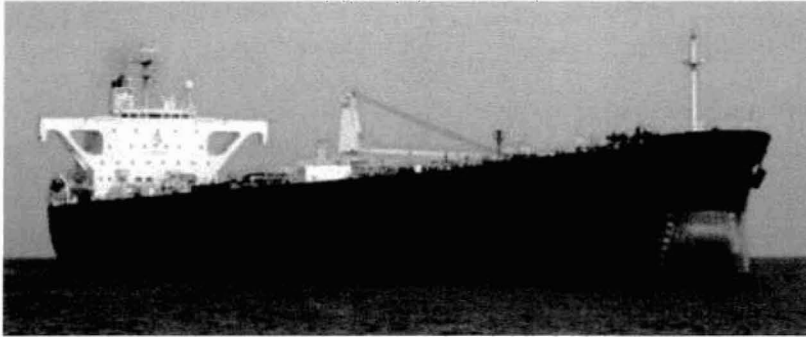


Figure 3: EAGLE OTOME prior to the incident

DIXIE VENGEANCE	
Flag:	United States
Official Number:	506543
Service:	Uninspected Towing Vessel
Year Built:	1966
Gross Tons:	143
Net Tons:	97
Length:	75 ft
Breadth:	24 ft
Depth:	10 ft
Propulsion:	Diesel Reduction
Horsepower:	1800
Owner:	Kirby Inland Marine LP
Operator:	Kirby Inland Marine LP

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010



Figure 4: DIXIE VENGEANCE prior to the
incident

KIRBY 30406	
Flag:	United States
Official Number:	995547
Service:	Grade A Petroleum Products
Inspection Subchapter:	46 CFR Subchapters D and O
Year Built:	1993
Gross Tons:	1619
Length:	297.6 ft
Breadth:	35 ft
Depth:	10 ft
Propulsion:	Not self propelled
Owner:	Kirby Inland Marine, LP
Operator:	Kirby Inland Marine, LP
Cargo Capacity 100%	30,400 bbls

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

KIRBY 28112	
Flag:	United States
Official Number:	1220958
Service:	Grade A Petroleum Products
Inspection Subchapter:	46 CFR Subchapters D and O
Year Built:	2009
Gross Tons:	1632
Length:	300 ft
Breadth:	35 ft
Depth:	10 ft
Propulsion:	Not self propelled
Owner:	Kirby Inland Marine, LP
Operator:	Kirby Inland Marine, LP
Cargo Capacity 100%	28,500 bbls

GULL ARROW	
Flag:	The Bahamas
IMO Number:	7930137
Service:	General Freightship
Classification Society:	Det Norske Veritas AS
Keel Laid:	1981
Gross Tons:	25,846
Net Tons:	11,543
Length (LOA):	597 ft
Breadth:	95 ft
Depth:	53 ft
Propulsion:	Diesel Direct
Horsepower:	11200
Owner:	Gearbulk Ship Owning LTD
Operator:	Kristian Gerhard Jebsen Skipshederi
Charterer:	Gearbulk UK LTD

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010



Figure 5: GULL ARROW prior to the incident

Personnel Data

Table 1: EAGLE OTOME crew data

EAGLE OTOME					
Name	Nationality	Age	Position	Maritime Ind. Experience	Time on Board
[REDACTED]	U.S.	[REDACTED]	First Pilot	21 years	1 prior transit 4 hours this trip
[REDACTED]	U.S.	[REDACTED]	Second Pilot	25 years	Prior transits 2 hours this trip
[REDACTED]	Indian	[REDACTED]	Master	12 years/2 years as Master	42 days
[REDACTED]	Filipino	[REDACTED]	Third Officer	4 years	3 months
[REDACTED]	Indian	[REDACTED]	Helmsman	7 years	8 months
[REDACTED]	Singaporean	[REDACTED]	Deck Cadet	3 months	3 months
[REDACTED]	Indian	[REDACTED]	Helmsman Prior Watch	21 years	7 ½ months
[REDACTED]	Indian	[REDACTED]	Second Engineer	13 years	4 months

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

[REDACTED]	Indian	[REDACTED]	Electrical Engineer	10 years	6 months
[REDACTED]	Bangladeshi	[REDACTED]	Chief Engineer	25 years	4 months
[REDACTED]	Indian	[REDACTED]	Bow Lookout	17 months	7 months
[REDACTED]	Indian	[REDACTED]	Third Assist. Engineer	17 years	42 days
[REDACTED]	Filipino	[REDACTED]	Second officer; prior nav watch; on deck at the time of the casualty	8 years	4 ½ months
[REDACTED]	Indian	[REDACTED]	Chief Officer	12 years	1 month

Table 2: DIXIE VENGEANCE crew data

DIXIE VENGEANCE				
Name	Age	Position	Maritime Ind. Experience	Time on Board
[REDACTED]	[REDACTED]	Relief Captain	10 years	1 year
[REDACTED]	[REDACTED]	Tankerman	2 years 9 mos.	1 year

Table 3: Injury data

Injuries			
Name	Age	Position	Injury⁶
[REDACTED]	[REDACTED]	Stevedore: GULL ARROW	Left side; left hand pain
[REDACTED]	[REDACTED]	Stevedore: GULL ARROW; Crane Operator	Neck and back strain
[REDACTED]	[REDACTED]	Stevedore: GULL ARROW	Back and abdomen strain
[REDACTED]	[REDACTED]	Stevedore: GULL ARROW	Head, shoulder, arm strain

⁴ The letters ATK are used as the individual's first name on his identification, documents and certificates.

⁵ FNU stands for First Name Unknown and is used on the individual's identification, documents and certificates.

⁶ Details of injuries had not provided as of the date of this report.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

Table 4: Port Arthur Vessel Traffic Service personnel data

VTS Port Arthur				
Name	Age	Position	Maritime Industry Experience	VTS Experience
██████████	██	Watchstander	25 years	2 years 5 mos.
██████████	██	Supervisor	13 years	8 years

Table 5: Parties in Interest

Party in Interest	Role	Counsel
██████████	First Pilot, EAGLE OTOME	Benckenstein and Oxford, LLP
██████████	Second Pilot, EAGLE OTOME	Benckenstein and Oxford, LLP
██████████	Master, EAGLE OTOME	Terry and Thweatt, PC
██████████	Master, DIXIE VENGEANCE	Jones, Walker, Waechter, Poitevent, Carrere & Denegre, LLP
██████████	VTS Watchstander	USCG Legal Services Command
American Eagle Tankers	Owner, EAGLE OTOME	Stevens, Baldo, Freeman and Lighty, LLP
Kirby Inland Marine, LP	Owner, DIXIE VENGEANCE, KIRBY 30406, KIRBY 28112	Stepp and Sullivan, PC
Gearbulk Ship Owning LTD	Owner, GULL ARROW	Eastham, Watson, Dale & Forney, LLP
Standard Tankers Bahamas, LTD	Charterer, EAGLE OTOME	Legge, Farrow, Kimmitt, McGrath, & Brown, LLP
Port Arthur International Port	Owner, pier	Sheldon & Dunham, PLLC
Sabine Pilots Association	Pilot Association	Calvert, Eaves, Clarke & Stelly, LLP
Jefferson and Orange County Board of Pilot Commissioners	Pilot Commission	Lewis, Brisbois, Bisgaard & Smith, LLP

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

Findings of Fact

1. The EAGLE OTOME is a tankship, which calls frequently in the petroleum ports along the U.S. Gulf Coast. The last Coast Guard examination prior to the incident, a Certificate of Compliance Exam, was completed on June 9, 2009 in Galveston, Texas with no deficiencies. The vessel's Safety Management System was reviewed and certificated by American Bureau of Shipping on October 25, 2008. The manuals on board were maintained with current updates. The vessel is classified by the American Bureau of Shipping and all surveys and documentation were current on the day of the casualty. All steering and propulsion systems were fully operational at the time of the casualty. All equipment on the bridge was also operational at the time of the casualty with the exception of a reduction in the effective range of the ship's VHF radio on the port side of the bridge. The ship arrived at anchorage on January 20, 2010 from Pajaritos, Mexico with 566,162 bbls of Olmeca crude, also designated UN 1267 - Petroleum Crude Oil. The cargo block of the tankship is divided into seven cargo tanks. Cargo tank No. 1 is a center tank. There are five pairs of wing ballast tanks with the forward and aft bulkheads of wing ballast tanks No.1 and 2 aligned with the forward and aft bulkheads of cargo tanks No. 1 and 2. Cargo tank number 1 was loaded with 45,161 bbls of crude oil.

Table 6: Time and Distance to stop for EAGLE OTOME, using full astern with minimum application of rudder

Engine Order	Time (minutes:seconds)	Distance (meters)
Full Speed	9:24	1600
Half Speed	7:23	1000
Slow Speed	6:50	800

2. Crew of the EAGLE OTOME: There were 28 mariners in the crew on the day of the incident including three deck cadets and two engineering cadets. The crew nationalities included 21 from India, 2 from both the Philippines and Malaysia, and one each from Singapore, Bangladesh and China. The bridge personnel on watch when the vessel weighed anchor on January 23, 2010 included the Master, the Second Officer, and an Able-Bodied Seaman as the helmsman. The Master had transited the Sabine-Neches waterway approximately 10 times prior to the incident. The navigation watch changed during the transit and at the time of the casualty, the bridge personnel included the Master, the Third Officer as the Officer of the Watch, a Deck Cadet alternating between bridge lookout and plotting fixes, and an Able Bodied Seaman as the Helmsman. An Ordinary Seaman was on the bow, and the Second Officer was on deck amidships at the base of the crane. The Second Engineer and the Electrical Engineer were on watch in the Engine Control Room while the Third Assistant Engineer was in the engine oil purifier area. The Master and Chief Engineer were considered day workers and did not work a fixed watch schedule. The Master had completed a course in Bridge Resource Management

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

(BRM)⁷ in March of 2009, and previously in February of 2005 and the Third Officer had completed a BRM course in November of 2008. The marine casualty investigators found that the officers on the bridge were skilled in speaking and understanding English, while the helmsman and bow lookout understood nautical English but needed an interpreter for detailed questions.

3. The first pilot on the EAGLE OTOME graduated from a maritime academy in 1988, received his third mate's license in May of 1989 and served with a number of companies, and as a master of a petroleum tanker for three and a half years, before receiving a commission as a Sabine Pilot on July 1, 2006. He received Bridge Resource Management training in 1999, and took an advanced shiphandling course during his second year of training to be a pilot. As a first class pilot, he was required to submit the results of a physical each year to the Coast Guard. He was issued a medical waiver on his license in 2008 for [REDACTED]. He was being treated for [REDACTED] with prescription medications. In 2008, he visited a sleep diagnostic center complaining of snoring and fatigue. He reported sleeping six hours a night. At that time, he was evaluated and diagnosed with [REDACTED] and prescribed a [REDACTED] machine. In 2009, he visited a sleep diagnostic center, reporting that he was not able to sleep due to discomfort from the [REDACTED] mask and reported he did not use the machine regularly. He was given a prescription for a [REDACTED] device, which is a dental device to position the jaw, which he did not fill. His 2009 physical for his Coast Guard license included information on his [REDACTED] and the medications prescribed at that time. He was re-issued a medical waiver for [REDACTED] treated by the specific medications in 2009 and instructed that if his condition for which the waiver had been issued changed, he must notify the Coast Guard within 30 days. The waiver was mailed and returned to the NMC in August/September of 2009 due to a change in address. The NMC initiated attempts to contact the mariner by e-mail to get a correct address to send the waiver, but efforts to contact the mariner were unsuccessful. In 2009, he was diagnosed with [REDACTED] and his medications were changed. His medications on the day of the casualty were [REDACTED]. All of his medications include possible side effects of drowsiness or fatigue. He reported experiencing no side effects from the medications. However, he had visited two sleep diagnostic centers since 2008 complaining of fatigue and snoring. Because he did not use the [REDACTED] machine for the diagnosed [REDACTED] it cannot be determined if the reported fatigue noted on his sleep study evaluations, was due to the [REDACTED] or a side effect of any or all of his medications, or a combination of medications and the untreated [REDACTED]. He did not notify the Coast Guard when his doctor added the diagnosis of [REDACTED] and changed his prescriptions. Mariners with medical waivers are required to notify the Coast Guard NMC of any changes to their conditions and or medications. The Coast Guard did not have any record of the [REDACTED] diagnosis. He testified that he did not use the [REDACTED] machine regularly and did not use it on any of the four days prior to the casualty.

4. Obstructive Sleep Apnea. Obstructive sleep apnea is characterized by a disruption of breathing while asleep caused by collapsing of the throat during sleep, which blocks the airway and, despite respiratory effort, prevents air from getting to the lungs. The disruptions last long

⁷ Bridge Resource Management courses teach a navigation team approach, and using all available resources including the observations and concerns of every member of the navigation watch during critical operations. Courses must meet the requirements of the Standards for Training, Certification and Watchstanding Code, Section B-VIII/2, Part 3-1.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

enough to miss one or more breaths. Symptoms include snoring, choking or gasping during sleep, sudden awakenings and daytime sleepiness. When the person stops breathing due to sleep apnea, the balance of oxygen and carbon dioxide in the blood is upset. The imbalance stimulates the brain to restart the breathing process. The brain stimulates the muscles of the tongue and throat to increase the size of the airway triggering the waking, choking and gasping often associated with sleep apnea. The open airway allows the carbon dioxide to escape and oxygen to enter the airway. Waking episodes are necessary to restart the breathing process. Though they are not always remembered, they are sufficient to significantly reduce the quality and quantity of sleep and cause daytime exhaustion. The main effects of sleep apnea are sleep deprivation and oxygen deprivation. Sleep deprivation is due to the frequent waking which prohibits therapeutic rest. The oxygen deprivation results from the buildup of carbon dioxide in the blood and affects the function of the brain, can cause heart disease, depression, high blood pressure and cognitive impairment including reduced functions of processing, learning and memory. Sleep deprivation is a major cause of motor vehicle accidents, and can impair the human brain as much as alcohol can. Sleep deprivation impairs coordination, causes longer reaction times and impairs judgment.

5. The second pilot on the EAGLE OTOME graduated from a maritime academy and received his third mate's license in 1985 and sailed with a number of companies on ships including dredge ships and offshore drilling vessels prior to becoming a pilot. He became a Sabine Pilot on July 1, 1999. He received Bridge Resource Management training as part of a shiphandling course in 1998 during his second year of training to become a pilot. He had been diagnosed with [REDACTED] and was prescribed [REDACTED]. He reported experiencing no side effects from his medication. As a first class pilot, he was required to submit the results of an annual physical to the Coast Guard. His physical supplied to the Coast Guard dated November of 2009 listed both a diagnosis of [REDACTED] and that it was well controlled on the medication with no side effects. He did not have a medical waiver on his license.

6. EAGLE OTOME was fitted with a basic Voyage Data Recorder (VDR) in compliance with IMO Resolution A.861(20) to collect data from various sensors on the bridge including a number of microphones arranged to capture audio recordings, including a microphone on the bridge and on each bridge wing. The data from the Automated Identification System⁸ (AIS) and Automated Radar Plotting Aid (ARPA) was also captured on the VDR. VDRs are required to retain 12 hours of voyage data. Following an incident the VDR is stopped to ensure the voyage data related to the incident is preserved for review. The VDR was stopped following the casualty and the data downloaded with the assistance of a technician and under the supervision of an investigator from NTSB.

7. American Eagle Tankers (AET) Inc. LTD is an international petroleum shipping company which owned or chartered 71 tankers at the time of the casualty and makes frequent port calls to U.S. ports following lightering in the U.S. Gulf of Mexico.

8. The DIXIE VENGEANCE is an uninspected towing vessel and is a canal push boat or towboat. It is designed to push barges ahead on inland rivers and canals, including the Gulf

⁸ The Automated Identification System is a shipboard VHF broadcast system that transmits GPS location information for ships, along with vessel name, official number and other details. AIS information is often plotted on electronic chart displays.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

Intracoastal Waterway. It is fitted with two engines, which drive two, four-blade propellers. The towboat also has two rudders and two flanking rudders forward of the propellers used to steer the vessel when going astern. While not subject to regular Coast Guard inspections, towboats are subject to the requirements of 46 CFR Subchapter C, the navigation requirements of 33 CFR part 164, along with other regulations. In anticipation of future regulations, the Coast Guard has developed a voluntary towing vessel examination program which awards a decal to vessels found to be in compliance with all applicable requirements. Following the casualty, the DIXIE VENGEANCE was examined under this program and five deficiencies were found, three for firefighting system deficiencies and a missing 11.8 inch bell and operating instructions for fuel shut off valves. The wheelhouse of the DIXIE VENGEANCE is fitted with radar, an AIS installation with a digital readout, and an electronic charting system capable of displaying AIS data for other vessels as well. The DIXIE VENGEANCE was made up with the bow of KIRBY 28112 as the stern barge, which was stern to stern with KIRBY 30406 as the lead barge. The configuration is called a unit tow.

9. KIRBY 28112 is a double hull tank barge with three cargo tanks divided into port and starboard tanks along the centerline. The barge was last inspected by the Coast Guard on August 18, 2009 and issued a Certificate of Inspection for a Lakes, Bays and Sounds route. Its planned transit between Beaumont and Baytown on the day of the casualty was within the scope of that route.

10. KIRBY 30406 is a double hull tank barge with three cargo tanks divided into port and starboard tanks along the centerline. The barge was last inspected by the Coast Guard on November 7, 2008 and issued a Certificate of Inspection for a Lakes, Bays and Sounds route. Its planned transit between Beaumont and Baytown on the day of the casualty was within the scope of that route.

11. The cargo on board both Kirby barges was UN #1993 Benzene, Dicyclopentadiene (Aromatic Concentrate). KIRBY 29112 was loaded with 26,516.66 bbls and KIRBY 30406 was loaded with 27,621.53 bbls.

12. Kirby Inland Marine operates the nation's largest fleet of inland tankbarges and towing vessels. The company was certified in 1998 under American Waterways Operators' Responsible Carrier Program (RCP), which applies standards that meet or exceed current regulatory requirements for safe operations and requires periodic third party audits of management as well as inland and coastal segments. RCP audits review company and fleet management policies, vessel equipment and human factors in vessel operations.

13. Crew of the DIXIE VENGEANCE. The four member crew of the DIXIE VENGEANCE was made up of two USCG licensed Masters of Towing Vessels and two documented mariners with ratings of Tankerman and Person-In-Charge. For a typical vessel in this segment of the industry, the licensed master and a tankerman stand a six hour watch twice a day. The crew includes an additional licensed master and tankerman. There are three teams of master and a mate. The senior master of the three is called the Captain, the next most senior is the Relief Captain, and the most junior master is called the Pilot. Each team of qualified master and tankerman spends four weeks on board (a hitch) and two weeks home. The master of the DIXIE VENGEANCE at the time of the casualty was the Relief Captain and he was standing the 0600 to 1200 and 1800 to 2400

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

watch with the tankerman. The pilot and a tankerman were on board sleeping at the time of the casualty. The Master of the DIXIE VENGEANCE had been in the marine industry with Hollywood Marine and Kirby Inland Marine for the last 10 years, coming up through the companies from deckhand, and had attended training programs and courses through Kirby Inland Marine and Seaman's Church up through captain's courses in 2006. His Coast Guard Master's license was issued in March of 2007. He was under a doctor's care for [REDACTED] and mild [REDACTED]. His medications were [REDACTED] and [REDACTED]. Side effects of [REDACTED] include wheezing, rash, hives, itching or swelling. Possible side effects for [REDACTED] include nausea, vomiting, loss of appetite, abdominal bloating and cramps. Possible side effects of [REDACTED] include nausea, headache, drowsiness and dry mouth. Possible side effects for [REDACTED] include flushing, headache and itching. Possible side effects for [REDACTED] include nausea, tiredness, shortness of breath and slow heart rate. His physical examination report submitted for his most recent license issue was current at that time and no waiver was required for the reported conditions. His [REDACTED] diagnosis and medication was more recent than the license issue and was reported by his doctors to be well controlled. He reported he experienced no side effects from any of his medications.

14. The GULL ARROW was a 28 year old general cargo carrier and was moored port-side-to at berth 2 at the Port of Port Arthur. The vessel was fitted with two gantry cranes for discharging cargo from each of four cargo holds. The Coast Guard conducted an International Ship and Port Facility Security Code exam on September 1, 2009 in Mobile, Alabama and found no deficiencies. The vessel was classified by Det Norske Veritas and all surveys and documentation were current on the day of the casualty.

15. The Port Arthur Vessel Traffic Service (VTS) is vessel traffic management and information service that was established in 2005 to enhance navigation, vessel safety, marine environment protection and to promote safe vessel movements, under the authority of the Coast Guard Captain of the Port, Marine Safety Unit Port Arthur.⁹ In contrast to some vessel traffic services throughout the country, regulations for VTS Port Arthur had not been published at the time of the casualty. Thus, the VTS issued advice and broadcasts information to inform mariners' navigation decisions. One exception to this was when there were waterway closures or other emergent situations. During those times, specific vessels may be issued orders under Captain of the Port authority, or the waterway may be closed to navigation under the same authority. The VTS received AIS information and had several cameras that give live video of the waterway. The VTS usually also had access to camera feeds from cameras owned by the Jefferson County Sheriff's Office, but those cameras, one of which could have seen EAGLE OTOME transit through the bridge, were not operating at the time of the casualty. The VTS monitored VHF channels 01A, 13, 16 and 65. The VTS also received information from NOAA's Physical Oceanographic Real Time System (PORTS) for weather and current from four current monitors. The VTS was operated 24 hours a day, 365 days a year and was staffed and managed by Coast Guard civilian employees. Watchstanders stood 12 hour watches working on and off the watch floor at various times during their shift. The VTS operating area was divided into two sectors: a northern sector and a southern sector. Each sector was assigned a single watchstander to broadcast traffic and weather information at 25 and 55 minutes after the hour, receive position

⁹ Vessel Traffic Service Port Arthur User Manual

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

reports and provide traffic information on request. The incident occurred in the southern sector of the VTS area. The watchstanders were authorized to provide specific navigation advice to ships underway in the operating area. Their radio procedures included using the vessel name in transmissions. The displayed information also included the unit numbers of the pilot on board, on the label associated with the icon of deep draft vessels underway in the operating area. The watchstanders did not display the historical track of a vessel as it would significantly clutter the display. Because the screen did not show the historical track, the watchstander could not interpret the EAGLE OTOME's position on the AIS display as indicating any increasing risk of a marine casualty.

16. The Sabine-Neches Waterway is a group of dredged channels and river segments that reaches from jetties extending into the Gulf of Mexico at Sabine Pass 64 miles through Jefferson and Orange Counties and includes the ports of Beaumont, Port Arthur and Orange, Texas. It also includes a portion of the Gulf Intracoastal Waterway (GIWW). It is the second largest shipping complex in Texas. Deep draft dry cargo vessels and petroleum tank ships use the waterway, entering from sea and proceeding up through Texas Island Intersection and on to the various facilities along the waterway. For 12 miles, from the Texas Island¹⁰ Intersection to the Neches River Intersection, the Sabine-Neches deep draft ship channel shares the waterway with the GIWW. It is the longest stretch of waterway shared between a deep draft ship channel and the GIWW in the nation. The casualty occurred in this section of the shared waterway. The deep draft ship channel dimensions are established and maintained by the Army Corps of Engineers. In the vicinity of the casualty the channel project dimensions are 400 feet wide by 40 feet deep. Other aspects of waterway management and commercial use are the responsibility of the Sabine-Neches Navigational District. All of the Sabine-Neches Waterway is within the VTS Port Arthur operating area. Commercial users, state and federal regulatory authorities meet regularly on safety issues as the South East Texas Waterway Advisory Committee (SETWAC). Under non-regulatory protocols developed between SETWAC and the Sabine Pilots Association, areas of the waterway are designated as no-meeting areas for deep draft vessels based on deadweight tons, length overall, or a combined beam or draft criteria. These protocols were most recently revised and re-issued on November 20, 2009. Assist and escort tugs are ordered at the discretion of pilots, to control the speed of inbound loaded tankers passing vessels berthed at certain facilities, or for other waterway operations requiring minimal wake. Two tug companies provide escort tugs for transits and assist tugs for berthing. Both conventional and tractor tugs work on the waterway with deep draft vessels. In the 12 months prior to the casualty, tugs met inbound ships in the vicinity of Texas Island Intersection almost 50% of the time.

¹⁰ The terms Texas Island and Texaco Island are used interchangeably.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

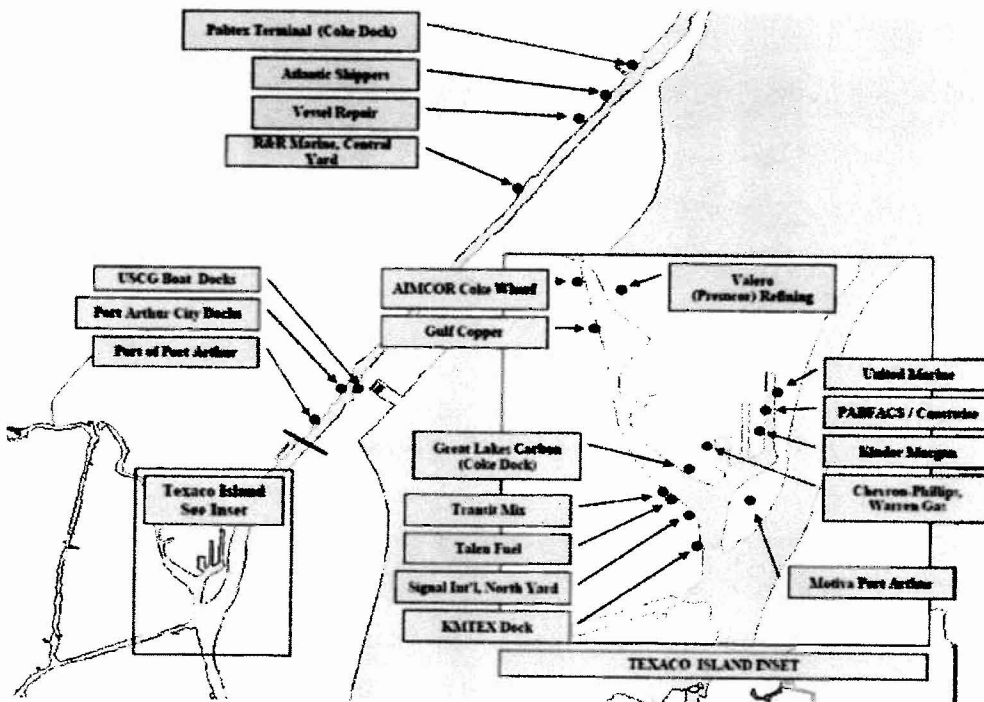


Figure 6: Graphic of the Sabine-Neches Ship Channel from VTS Port Arthur Users Manual

17. Pilotage. Foreign vessels and U.S. flag vessels sailing on register transiting the Sabine-Neches Waterway are required by state law¹¹ to take on a pilot commissioned by Texas. All of the pilots in the Sabine Pilots Association are commissioned by the state of Texas. U.S. flag vessels on voyages from other U.S. ports must have a Coast Guard licensed master with an endorsement for pilotage on the Sabine-Neches Waterway, or take on a first class pilot from the Sabine Pilots Association.

18. The Sabine Branch Pilots are commissioned under the regulatory authority of the Jefferson and Orange County Board of Pilot Commissioners. The Board commissions pilots, determines the number of pilots, reviews the pilotage rates and reviews the commissions of pilots every four years. The Commission issued to the Pilots comes from the Board and is signed by the Governor and Secretary of State of Texas. The Board of Pilot Commissioners is charged with determining the mental and physical fitness of the pilot. The Board accomplishes this through the pilots' possession of a Coast Guard license and an interview with the pilot. In the language of the state

¹¹ Texas Transportation Code, Chapter 69 Jefferson and Orange County Pilots Licensing and Regulatory Act

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

statute, 'pilot services means acts of a pilot in conducting a vessel through the navigable water in this state and the ports in which the pilot is licensed or certified as a pilot.'¹²

19. Pilotage services are provided for the waterway by the Sabine Pilots Association, which provides the organization and infrastructure for pilotage. The individual pilots are independent contractors to the ships when they are performing pilotage services. The Association provides dispatch services, manages billing, oversees a training program, and manages and crews the Association's four pilot boats stationed at Sabine Pass. The president of the Association meets regularly as part of SETWAC and co-signed the most recent version of the ship traffic protocols. These protocols also include a requirement for vessels to take two pilots if they exceed 860 feet in length or 120 feet of beam. The President of the Association and both pilots testified that the two pilot system for these larger vessels was intended to increase the safety of the transit. The protocols, including the two pilot system were put in place in the early 1980's and were reviewed and reissued without changes in 2009. Also in the 1980's, the Association developed internal guidance to the pilots, which dictated locations for the two pilots to hand over the conn, as well as duties divided between the two pilots. The guidelines had not been recently revised. The duties assigned to each pilot under the guidelines were not being observed by the two pilots on the day of the casualty, specifically the guidelines stated that the pilot not on the conn was to handle radio communication and miscellaneous. Miscellaneous according to the guidelines included assisting the pilot conning the vessel per his request, assisting by providing information whenever dense traffic conditions prevailed, and items such as inspection of the ships particulars, arranging for tugs and briefing mooring arrangements.

20. Training and commissioning. A candidate wishing to train to become a Sabine Pilot must be first chosen by vote by the Sabine Pilot Association and then be selected by the Board of Pilot Commissioners before entering the training program. The training program for a Sabine Pilot involves a year as an apprentice, riding six days each week with an individual pilot on all vessels assigned. This allows an apprentice to ride with every pilot in the Association and allows for exposure to nearly every vessel type required to take a pilot on the waterway. Halfway through the first year, the apprentice sits for the Coast Guard licensing examination for first class pilot and, upon successful completion, the individual completes the apprentice year and must be awarded a deputy pilot commission by the Board of Pilot Commissioners in order to continue to train to be a pilot. During the second year, the deputy pilot is alone as he or she pilots vessels of increasing gross tonnage and draft. At the end of the second year, he or she is able to pilot vessels of up to 75,000 gross tons and 40 foot draft. Any vessel larger than 75,000 gross tons has to be piloted by a full branch pilot. During this second year the deputy pilot must also complete an advanced shiphandling course including simulator training and emergency shiphandling procedures. On successful completion of the deputy year, the individual may receive his Texas Pilot commission.

21. State law gives the Board the authority to investigate marine casualties involving pilots. The Chairman of the Jefferson and Orange County Board of Pilot Commissioners testified that the Board investigates all marine casualties¹³ and complaints involving a pilot but that Sabine Pilots had not had a single pilot complaint since 1989. He testified there had not been a single casualty

¹² Ibid.

¹³ Marine Casualty as defined by 46 CFR Part 4 according to his testimony.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

investigation since at least 1979 when there was a collision involving two piloted ships. However, according to Coast Guard records, there were 779 marine casualties, including 53 Reportable Marine Casualties, eight Serious Marine Incidents and five Major Marine Casualties since 2001 involving Sabine Branch Pilots operating under their state licenses. The Board does not have any requirement that pilots report incidents to the Board. Despite the Board of Pilot Commissioners' responsibility to oversee the performance of pilots for the safety of the ports and waterways of Jefferson and Orange County, the Chairman testified that the Board does not exercise any control over the day to day activities of individual branch pilots. The Board of Pilot Commissioners makes no separate or independent evaluation of the health of commissioned pilots. There is no requirement or mechanism for the Board to have reviewed or evaluated the first pilot's medical conditions to determine if the conditions, medications or any combination affected his ability to perform as a pilot. There are no performance guidelines issued by the Board to pilots and no evaluation of the performance of pilots, including when two pilots are working together on a single ship.

22. Shiphandling. Navigating ships in narrow channels presents specific challenges not encountered to the same degree in other environments. Chief among these is the effect of bank suction. Bank suction is defined as the tendency of a vessel traveling near a steep underwater bank to move sideways toward that bank while an opposing force pushes the bow away.¹⁴ The effect of suction starts when a vessel strays too close to a bank, restricting the water flow on its bank side. The water flow velocity increases, causing the water between the vessel and the bank to flow out of the area faster than it can flow back in. this causes the water pressure to drop and consequently the vessel is pulled sideways toward the bank. The magnitude of the suction increases with the speed of the vessel and is more pronounced when the channel is sloped versus straight up and down. The low pressure draws the stern of the vessel in toward the bank despite the position of the rudder. In the Sabine Neches Waterway, it is not uncommon for deep draft vessels to encounter bank suction and begin to sheer to the opposite side of the channel. Another effect that must be accounted for is the cushion effect of the bow wave against the channel face which tends to push the bow away from the side of the channel. Again, this effect is more pronounced with increased vessel speed. The common method to recover control of the vessel experiencing bank suction is to employ a hard rudder and increase the engine speed or revolutions per minute (RPM).^{15,16} This puts more water across the face of the rudder, increasing its effectiveness in turning the ship. A review of a number of VTS records of transits of loaded tankships, shiprides by the investigative team and the testimony of the Pilot Association President indicated the Sabine pilots routinely use this technique with good success. Vessels with longer overall length present a greater challenge in recovering from bank suction and sheer since they may quickly encounter the effects of the opposite bank before regaining control.

23. Transits of loaded tankships in the Sabine-Neches Waterway. The speed of the EAGLE OTOME in various portions of the transit prior to Missouri Bend was not significantly different than several other transits of loaded tankships recorded by Port Arthur VTS and observed by marine investigators. In addition, the draft of EAGLE OTOME at 39 feet was not significantly different than the drafts of other AFRAMAX tankers entering the Sabine-Neches Waterway. The

¹⁴ R.S. Crenshaw, Jr. *Naval Shiphandling*, 4th ed., 1975, Naval Institute Press, Annapolis, MD

¹⁵ Ibid.

¹⁶ C. J. Plummer, *Ship Handling in Narrow Channels*, 3rd ed., 1978, Cornell Maritime Press, Cambridge, MD

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

use of shuttle tankers the size of EAGLE OTOME is very common in the Sabine-Neches Waterway and each pilot assigned to EAGLE OTOME had experience with conning hundreds of loaded tank vessels of similar size and draft over the course of their careers.

Table 7: 96 Hour Rest History: Values in italics were reported as hours off work, off duty or rest. Values in regular text were reported as hours slept.

Mariner ¹⁷	Tues	Tues - Wed	Wed	Wed- Thurs	Thurs	Thurs- Fri	Fri	Fri- Sat
First Pilot	0	6.5-7	0	6.5-7	0	0	7	5.5
Second Pilot	0	7	0	6	0	7	0	7
Master, EO	3	12	6	12	5	12	5	11
3rd Off, EO	4	8	4	8	4	8	4	7
Helm, EO	5	7	5	7	5	7	5	7
Elec Eng EO		8		8		8		5
2nd Eng EO		8		8		9		6
Bow OS EO	4	8	4	8	4	9	3	9
Master, DV	4	5	4	5	4	5	4	5

24. Table 7 shows that all of the mariners on duty at the time of the casualty had received between six and nine hours of sleep each day prior to the incident with the exception of the first pilot. The first pilot received no sleep Thursday through Friday morning, piloting two ships in a row, and reported sleeping seven hours during the day on Friday and 5.5 hours before waking at 0230 to go to the ship. The first pilot reported he usually slept between six and a half to seven hours per night. All of the mariners reported sleeping well and feeling rested.

Casualty Timeline

25. At 0330 on January 23, 2010, the EAGLE OTOME engineers reported to the bridge watch that they completed satisfactory pre-arrival engine and steering gear tests while the ship was anchored at Sabine Fairway Anchorage, riding on her port anchor.

26. At approximately 0524, the first pilot boarded EAGLE OTOME and took the conn from the master and proceeded into the Sabine-Neches Waterway on even keel with a draft of 39 feet. The pilot greeted the master, ordered Full Ahead and started conning for the sea buoy. The master-pilot exchange, a discussion of the passage, tugs, the weather or the ship's characteristics, was not conducted at that time. However, some details of the weather, the ship's destination as the Exxon-Mobile Refinery and arrangements for tugs to meet the vessel were discussed in the hours prior to boarding the second pilot.

¹⁷ EO Crew values are hours not on duty or working if in Italics, otherwise, reported hours slept. Pilot and DV hours are reported sleep.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

27. At 0620, the first pilot discussed taking at least one tug at Rainbow Bridge in order to slow for vessels moored at the Total Petroleum facility. Other details of the transit were discussed during the transit through the fairway.

28. At approximately 0625, the master and the first pilot discuss the steering characteristics of EAGLE OTOME and the first pilot remarks that "you want to save a bell going into or out of a turn to give it a kick."¹⁸ In this conversation, the first pilot discusses not knowing the tide but thinking he had a little bit of an ebb.

29. At 0710, cargo operations began on GULL ARROW, moored port side to, pier 2 at the Port of Port Arthur. 32 stevedores were aboard offloading bulk paper from cargo holds 2 and 3.

30. At 0749, the first pilot broadcast EAGLE OTOME's position on VHF channel 13 using the vessel name and announced he was running slow in reduced visibility due to fog in the vicinity of Sabine Pass. The first pilot did not discuss anchoring due to the fog and made no preparations to anchor due to the fog. (Note: fog and reduced visibility was not a factor in the casualty. The fog lifted later in the transit as discussed in paragraph 33.)

31. At 0752 the second pilot boarded EAGLE OTOME in Sabine Pass and took the conn from the first pilot. The second pilot begins to discuss preparations to anchor the vessel in the vicinity of New Cut with the master due to reduced visibility from fog.

32. At 0756 the second pilot notified Port Arthur Traffic of his intention to anchor in Goat Island Cut. As visibility improved, the decision was made to continue with the transit.

33. Weather at approximately 0850 was wind out of the Southeast at 10 mph, visibility at 6 miles and fog/mist lifting to an overcast sky. Temperature was 65 degrees Fahrenheit. NOAA PORTS data recorded a ½ knot to 1 knot flood in the vicinity of the West Port Arthur Bridge.¹⁹

34. At 0904, about a mile south of Texas Island Intersection, the first pilot relieved the second pilot of the conn.

35. At 0914 the first pilot broadcasted his position, checking on any outbound, westbound traffic at the MLK Bridge and Port of Port Arthur, on VHF Channel 13 as the "first of two inbound tankers a mile south of Texas Island" and did not use the name EAGLE OTOME.

36. At 0915 the Master of the DIXIE VENGEANCE answered the broadcast on VHF 13 as the DIXIE VENGEANCE westbound three miles from the MLK Bridge.

37. At 0923:06 the Master of the DIXIE VENGEANCE broadcast her position on VHF 13 as DIXIE VENGEANCE southbound at the Schoolhouse with two loads.

¹⁸ The first pilot stated in interviews that 'give it a kick' meant increase engine RPM.

¹⁹ NOAA PORTS data is the Physical Oceanographic Real Time System and indicates actual measured conditions.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

38. At 0923:18 the first pilot on the EAGLE OTOME answered the Master of the DIXIE VENGEANCE as the first of two loaded tankers, $\frac{3}{4}$ of a mile below the bridge. The two agreed to meet on one whistle (a port to port passing arrangement).

39. The Master and Third Officer on the EAGLE OTOME testified they were unaware of the passing arrangements or that EAGLE OTOME would meet the downbound towboat.

40. At 0923:30 the first pilot on EAGLE OTOME asked if DIXIE VENGEANCE is making any time.

41. At 0923:34 the Master of the DIXIE VENGEANCE answered that the vessel is making almost eight, 7.9. The master testified he was giving his speed in miles per hour. According to the AIS data, the DIXIE VENGEANCE was traveling at 6.9 knots or 7.9 miles per hour.

42. At 0923:40 the first pilot of the EAGLE OTOME answered that he will be slowing down for the ship at the Port of Port Arthur. The pilot testified he did not want to go too fast past the ship at the port of Port Arthur because of the effect of the tankship's wake on the vessel at the berth.

43. At 0923:45 the Master of the DIXIE VENGEANCE acknowledged and stated if the pilot wanted him to speed up or slow down, to let him know. The Master of the DIXIE VENGEANCE testified that he had previously met a deep draft vessel in the vicinity of the MLK Bridge and wished to avoid meeting this tanker in that location.

44. At 0923:49 the first pilot on the EAGLE OTOME answered "I don't think so at this point." The pilot testified he expected to slow down and meet the DIXIE VENGEANCE between the MLK Bridge and the Port of Port Arthur.

45. The events of the transit that occurred between the passing arrangements and the casualty include helm and engine orders, conversations on the bridge of the EAGLE OTOME and radio traffic. These occurred over a period of 12 minutes. In order to capture these events with the context provided by vessel speed and rate of turn, they are displayed in Table 8. Table 8 chronicles a series of sheering events, indicated by high rates of turn, that were answered with hard helm orders and increased engine RPMs from Slow Ahead to Half Ahead and from Half Ahead to Full Ahead. The table also shows the hard rudder commands were in effect for minutes at a time as the vessel sheered between the banks of the channel. Finally, the table shows unanswered radio calls made by DIXIE VENGEANCE and the delay in the release of EAGLE OTOME's starboard anchor.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

Table 8: Casualty Timeline

Time From vessel GPS unless otherwise noted.	Helm Order Helm order given by the first pilot, repeated by the helmsman	Engine Order Engine order given by the first pilot, repeated by the third officer unless otherwise noted.	Rate of Turn²⁰ (ROT) (deg/min) Rate of turn is positive to the right and negative to the left.	Speed²¹ (kts)	Note
0923:55	Hard Stbd	Half Ahead ²²	0.0	7.6	Mid channel Missouri Bend
0924:10	Starboard 10			7.6	Bow started swinging to the right
0924:18		Slow Ahead	5.4	7.6	
0924:41	Starboard 10		12	7.5	It is unclear if this is a repeated order or a helm order was given that is not heard on the VDR
0924:56	Starboard 20		17	7.3	
0925:04	Midship		17	7.3	EO is on the port side of the channel
0925:08	Hard Port		20	7.2	
0925:23		Half Ahead	15	7.1	
0926:20	The second pilot made a comment or asked a question with the words "drop down." The bow of the EAGLE OTOME swung to the right, crossed the middle of the channel toward the starboard side of the channel.				
0926:31		Slow Ahead	-4.8	6.7	
0926:35	Port 20		-3.6	6.7	The rudder had been hard to port for nearly 1 ½ minutes
0927:07	Starboard 10		-5.4	6.6	The ECDIS shows the vessel well on the starboard side of the channel.
0927:18	Starboard 20		-6.0	6.5	
0927:50		Half Ahead	-10	6.2	
0928:14	The first pilot asked the second pilot, "she gonna come back, Dave?" Although it isn't heard clearly on the VDR, the pilots each testified that the second pilot responded, "Eventually" meaning the ship would eventually come under control. The ECDIS showed the vessel was less than half a ship length from the MLK Bridge with the bow across the middle of the channel going to the green side of the channel.				

²⁰ Rate of Turn data from EO VDR

²¹ Speed data from EO VDR unless otherwise noted

²² Ordered at 0919.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

Time From vessel GPS unless otherwise noted.	Helm Order Helm order given by the first pilot, repeated by the helmsman	Engine Order Engine order given by the first pilot, repeated by the third officer unless otherwise noted.	Rate of Turn²³ (ROT) (deg/min) Rate of turn is positive to the right and negative to the left.	Speed²⁴ (kts)	Note
0928:44		Full Ahead	0	6.1	The bow of EAGLE OTOME was coming under the MLK Bridge, The bow was swinging right and the stern was starboard of midchannel
0928:58		Half Ahead	2.4	6.1	
0929:06	Midship		6	6.1	
0929:18	Port 20		8	6.1	
0929:49	Midship		9	6.0	
0929:53	Port 10		9	6.1	
0930 ²⁵	Master, DV testified he saw the EAGLE OTOME in vicinity of the bridge toward the green side of the channel. He lost sight of EAGLE OTOME as DIXIE VENGEANCE was coming around a small bend by the fishing boats.				
0930:05	Hard Port		4.8	5.9	
0930:13		Slow Ahead	9.6	6.0	
0930:30 thru 0930:58	Second Pilot and Master conversation about Wall Street Journal.				
			9	6.2	
0931:07 thru 0931:11	First pilot asks Master to have a man forward in case they need to use the anchors				
			10.2	6.2	
0931:11	Master replied yes, "we have a person...all the time..."				
0931:23	Master calls OS on bow w/ship's handheld radio				
0931:27		Half Ahead	12	6.1	Ship was swinging right to the red side of the channel
0931:29	Second pilot: "Take care of the ship, don't worry about the one at the dock."				

²³ Rate of Turn data from EO VDR

²⁴ Speed data from EO VDR unless otherwise noted

²⁵ Estimated time based on testimony and reported position of each vessel.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

Time From vessel GPS unless otherwise noted.	Helm Order Helm order given by the first pilot, repeated by the helmsman	Engine Order Engine order given by the first pilot, repeated by the third officer unless otherwise noted.	Rate of Turn ²⁶ (ROT) (deg/min) Rate of turn is positive to the right and negative to the left.	Speed ²⁷ (kts)	Note
0931:45	Second pilot: "Rapido." The second pilot testified that he said this to suggest the first pilot to give an additional engine bell. The first pilot testified that he understood the word to suggest he should give an additional engine bell.				
0931:47		Full Ahead	6.6	5.9	
0931:49	Master: "I can give more RPM also sir, just tell me when."				
			3	5.9	
0932:07		Half Ahead	0	6.0	
0932:33	Midship		-14.4	6.1	Rudder was hard port for 2 ½ minutes
0932:43	Hard Starboard		-21.6	6.1	Ship far to red side of the channel
0932:50 thru 0933:10	Master to OS on Bow: "...Dharmender....Remove the bar ²⁸ ..."				
			-19.2	6.1	
0933:12 thru	First pilot to second pilot: "Dave, will you talk to this next tow..."				
0933:33			-12	6.0	
0933:35		Full Ahead	-12	5.8	
0933:42	Beeps consistent w/operation of Engine Order Telegraph. EOT log is not synched to GPS clock, but shows Nav Full, Full Ahead and Stop, all on the same time stamp. At this time, the Master has replaced the Third Officer operating the EOT. He testified he intended to order Nav Full using the EOT and a bypass button but instead set the EOT to Nav Full and hit the emergency stop button. The pilot was not aware that Nav Full was ordered and was not aware the engine was stopped.				
			-12	5.7	
0933:45			-10.2	5.8	Alarm
0933:48	First pilot to Master: "Captain, let go that starboard anchor!"				
			-11.4	5.8	
0933:51 thru 0933:58	Master to bow: "Let go stbd anchor, forward, let go stbd anchor, open the bar, let go!..."				
			-11.4	5.7	
0933:55	Master, DV on VHF13, "You sure are wide." The Master DV testified he said this because of the vessel's width. The EAGLE OTOME is on the far red side of the channel.			6.7	
			-12	5.7	

²⁶ Rate of Turn data from EO VDR

²⁷ Speed data from EO VDR unless otherwise noted

²⁸ The 'bar' is a steel bar through the anchor chain. It must be removed before the brake is released for the anchor to fall.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

Time From vessel GPS unless otherwise noted.	Helm Order Helm order given by the first pilot, repeated by the helmsman	Engine Order Engine order given by the first pilot, repeated by the third officer unless otherwise noted.	Rate of Turn²⁹ (ROT) (deg/min) Rate of turn is positive to the right and negative to the left.	Speed³⁰ (kts)	Note
0934:00	First pilot: "don't know what else to do."				
			-14.4	5.6	
0934:02	Master to bow: "Let go stbd anchor, let go stbd anchor, right now, let go"				
			-13.2	5.6	
0934:06		Full Astern	-15	5.6	
0934:10- 0934:28	Call from engine room instructing to Master, helm orders to reset the engine order telegraph. "Hello? Hello? OK, Start ...start again. Already, Already, sir, OK..."				
		Full Astern Stop D Slow Ahead Stop Half Astern Em'cy Full Slow Astern			EOT orders ³¹
0934:17	Master, DV on VHF 13, "DIXIE VENGEANCE, inbound ship, lookin' OK?" The Master of the DV testified he said this as he saw the bow of EAGLE OTOME begin swinging left across the center of the channel.			6.5 ³²	
0934:24	The first pilot walked out to the port bridge wing to observe the allision and sounded the danger signal out on the bridge wing.		-16.2	5.5	EO Danger Signal sounded. Only the horn on the bow was sounded and the signal was not heard on the bridge.
0934:24 Estimated based on testimony	Master, DIXIE VENGEANCE heard danger signal, set throttles to full astern, sounded the General Alarm and his own Danger Signal			6.5	
0934:30 thru 0934:38	Master to bow, "Open the brake, stbd anchor, open the brake!" Response from bow not heard. Master to bow: "Let go, let go, let go!"				
			-12	5.5	Stbd Anchor released

²⁹ Rate of Turn data from EO VDR

³⁰ Speed data from EO VDR unless otherwise noted

³¹ Engine Order Telegraph time stamp was not synchronized with GPS clock. Timestamp only has 0.5 minute intervals. All of these orders are within the same time stamp.

³² The EO VDR recorded the AIS transmission of DV's speed as 6.5kts. The data is transmitted every 2 to 10 seconds so the 6.5 kt speed may not have been the instantaneous speed at 0934:17.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

Time From vessel GPS unless otherwise noted.	Helm Order Helm order given by the first pilot, repeated by the helmsman	Engine Order Engine order given by the first pilot, repeated by the third officer unless otherwise noted.	Rate of Turn³³ (ROT) (deg/min) Rate of turn is positive to the right and negative to the left.	Speed³⁴ (kts)	Note
0934:38	Second pilot cell phone call to pilot on tankship behind EO, "he's got a big ... problem, we're about to hit the Gearbulk, bye."				
			-15.6	5.5	
0934:53 thru 0935:09	EAGLE OTOME hit GULL ARROW		-13.8	5.3	
0935:24	EAGLE OTOME collided with DIXIE VENGEANCE		17.4	3.4	No. 1 Port Ballast Tank, No 1 Cargo Tank breached, oil discharged
				DV=4.6	Port coupling between cargo barges broke

³³ Rate of Turn data from EO VDR

³⁴ Speed data from EO VDR unless otherwise noted

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010



Figure 7: AIS tracks for EAGLE OTOME and DIXIE VENGEANCE plotted on a satellite image of the Sabine-Neches Waterway beginning at the time of the passing agreement.

46. The pilots relieved one another of the sole responsibility of piloting at discrete locations along the waterway. When asked for advice on the ship's second sheer, following the comment of "Eventually," the second pilot stopped observing the progress of the transit until the first pilot requested the master to ensure there was a man forward in case the anchors were needed. In

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

addition, the second pilot recommended additional speed, despite the fact that several attempts at added speed had failed to bring the vessel under control.

47. Steering machinery, main engines and auxiliaries were tested following the casualty in the presence of ABS on January 26 and all were found operating satisfactorily. The engine room alarms were reviewed and no steering or engine alarms were detected with the exception of the low lube oil alarm sounded with the emergency engine shutdown.

48. Damage to the EAGLE OTOME included port side shell and upper deck plating in the way of the No. 1 Port Ballast Tank were set in. The deck plating cracked and separated from the sideshell and the stanchions in the area were bent and broken. On the starboard side, the side shell plating at the loaded waterline in the way of the No. 1 Starboard Ballast Tank was punctured between frames 90 and 95. Damage extended to the internals and the No. 1 Center Cargo Tank was punctured. The vessel made contact with the bottom of the channel at the stern. It is uncertain if dry dock repairs to shell plating on the starboard side at the stern are related to the grounding or not.

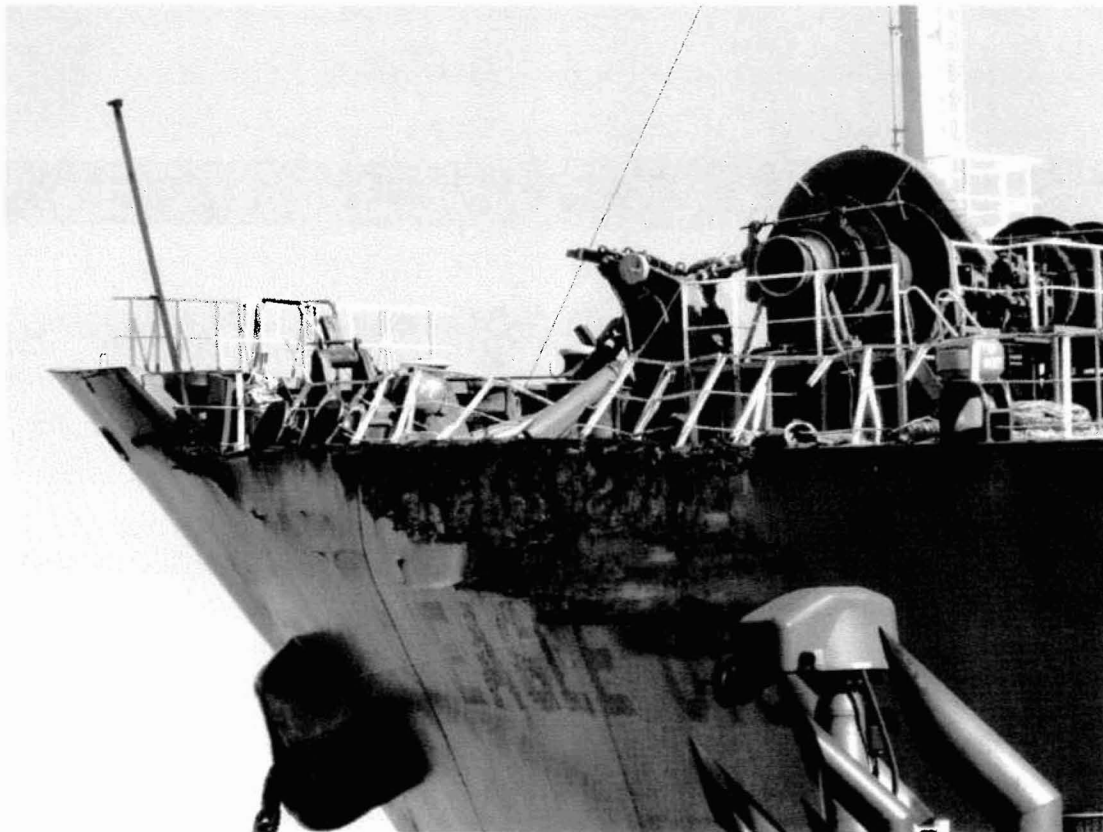


Figure 8: Damage to EAGLE OTOME port side bow.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010



Figure 9: Damage to starboard bow of EAGLE OTOME in No. 1 Starboard Ballast Water Tank and No. 1 Center Cargo Tank.

49. Damage to the KIRBY 30406 included damage to the forward rake, including replacing or rebuilding 30 feet by 10 feet of the barge on the starboard side, replacing the barge push knees and the following internals: 18 longitudinals, 18 deck longitudinal stiffener plates and 16 vertical stiffener plates.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

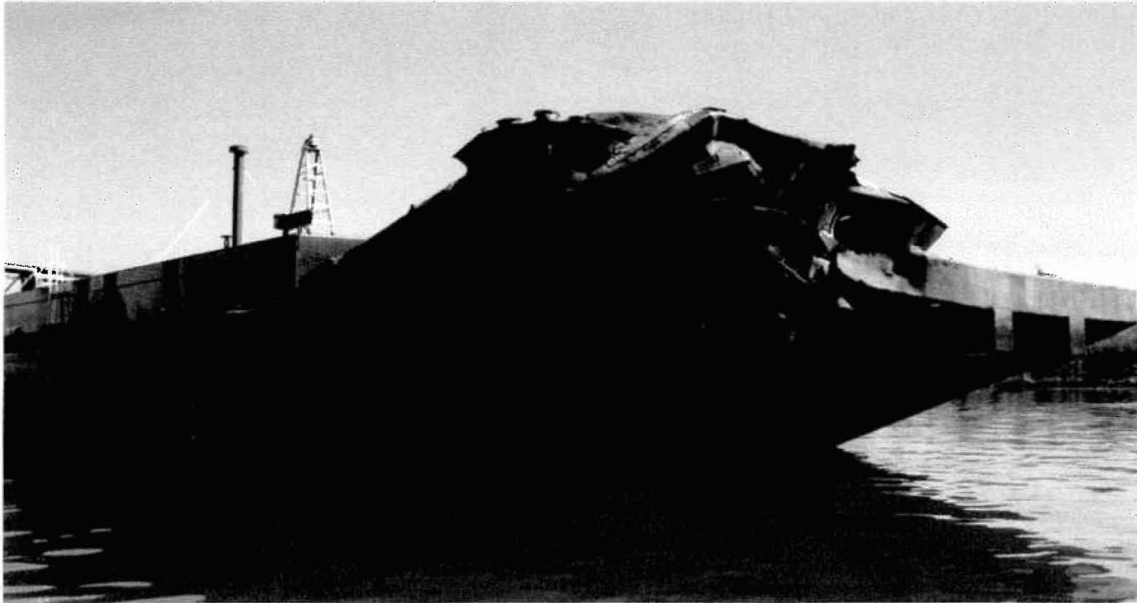


Figure 10: Bow damage to KIRBY 30406

50. Damage to the GULL ARROW included indentation from frames 29 through 55 around the first longitudinal stiffener below the main deck. The ship's hull was ruptured from frame 32 through 53. Systems affected included piping for ship's service air, lube oil, and sewage. The ship's accommodation ladder (deployed on the port side during the incident) was also damaged. Also on the port side, shell plating and buckling of eight frames in way of No. 2 Port and No. 3 Port ballast tanks. Buckling was also found in #7 Port Fuel Oil settling tank and Sludge Tank #7 Starboard.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

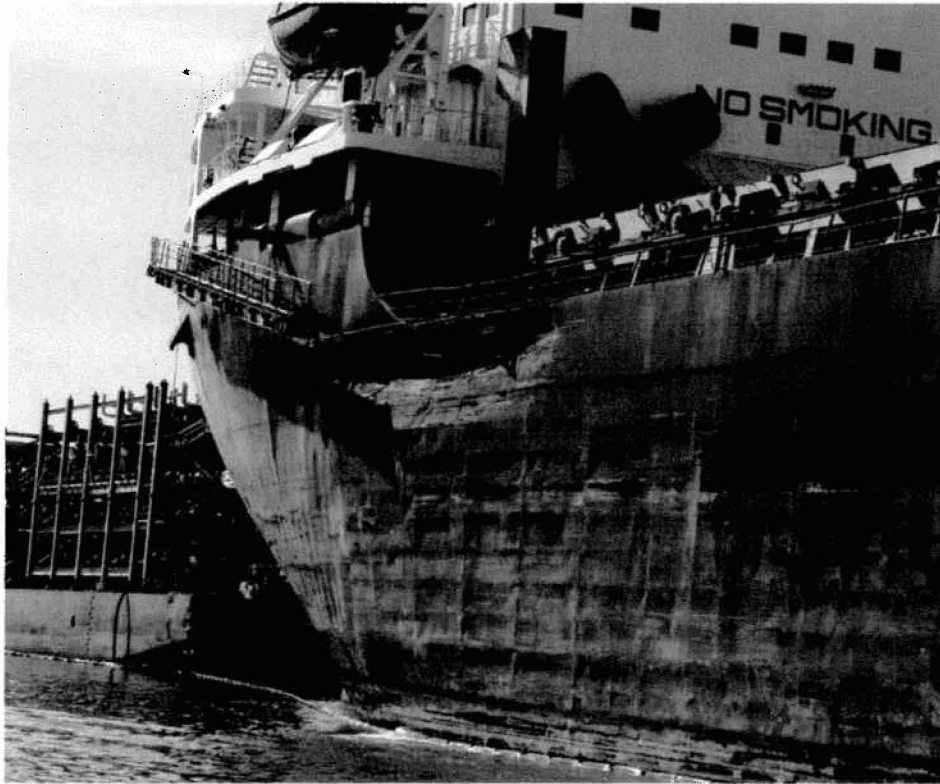


Figure 11: Damage to starboard side of GULL ARROW.

51. Damage to Berth 2 at the Port of Port Arthur included 193 feet of the fendering system set inshore and upstream over the full height of the fendering system. The system is 12 inch by 12 inch treated timbers on 12 inch steel H-beams with rubber fender blocks, galvanized chain and fittings. Damage also included some spalling and fractures in the concrete dock structure over a span of 60 feet.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010



Figure 12: Damage to Berth 2, Port of Port Arthur

52. Chemical Testing Results. Alcohol results for the crew of the DIXIE VENGEANCE, the crew of the EAGLE OTOME and the two pilots were [REDACTED]. The two VTS employees were not alcohol tested as they are only subject to drug screening under Coast Guard policy. The two VTS employees were drug tested according to the DOT criteria for controlled substances, with [REDACTED] results, however they were not subjected to the expanded chemical testing. All drug tests for controlled substances were [REDACTED]. Table 9 gives the results of expanded chemical testing of mariners on watch. The testing was performed in accordance with Coast Guard policy. No other mariners on watch at the time of the casualty had chemicals detected in their urine.

Table 9: Laboratory Results for Expanded Chemical Testing. Laboratories involved in conducting testing included Kroll Laboratories, Gretna, LA; One Source Toxicology, Pasadena, TX and FAA Civil Aerospace Medical Institute, (CAMI), Oklahoma City, OK.

Person	Expanded Testing Result	Date of Result	Notes
First Pilot	[REDACTED] detected in Urine [REDACTED] Metabolite detected in Urine [REDACTED] detected in Urine [REDACTED] n detected in Urine [REDACTED] am detected in Urine	March 16, 2010	Findings consistent with prescription drug use as self-reported.
Second Pilot	[REDACTED]	March 16, 2010	[REDACTED] is for [REDACTED] Expected finding

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

			when taking [REDACTED] is a potassium-sparing diuretic.
Master, DIXIE VENGEANCE	[REDACTED] detected in Urine [REDACTED] detected in Urine [REDACTED] detected in Urine	March 16, 2010	These results are consistent with the declared use of prescription drugs.
Tankerman, DIXIE VENGEANCE	Naproxen	March 10, 2010	Naproxen is an anti-inflammatory available as over the counter medication
Electrical Engineer, EAGLE OTOME	[REDACTED] Detected in urine	March 11, 2010	Beta-Blocker to treat [REDACTED]
2 nd Engineer, EAGLE OTOME	[REDACTED] Detected in urine	March 11, 2010	Drugs to treat [REDACTED]

Analysis

The transit of the EAGLE OTOME is the product of the larger system of vessels transiting the Sabine-Neches Waterway. Accidents occur in systems when a threat, exposed by an initiating event, is fostered by a number of unsafe acts, latent unsafe conditions and preconditions, and is allowed to progress through the system's defenses until an incident occurs. Casualty analysis involves identifying the latent unsafe conditions in the people, workplaces and organizations, and then identifying why the defenses failed that would have protected the system from those latent unsafe conditions. The model is graphically represented as layers of Swiss cheese where the holes line up to allow the threat to progress uninterrupted through the layers. This section of the report analyzes the cause of this casualty by classifying the organizational and workplace factors that contributed latent unsafe conditions to the casualty, identifying the reasons that the defenses failed that would have prevented the casualty.

Initiating Event

1. The Initiating Event is the first unwanted outcome in the series of events of the transit. In this case, the initiating event was the bank suction experienced by the EAGLE OTOME as it exited Missouri Bend. This was followed by the first of four sheering events, each increasing in severity, that led to the allision with the GULL ARROW and collision with the barge KIRBY 30406 pushed by the DIXIE VENGEANCE. It is not uncommon for a loaded tankship to encounter bank suction coming out of a bend in a narrow channel, however the pilot must maneuver deliberately to regain control of the vessel. The EAGLE OTOME was out of control as it responded to this bank suction and then began to sheer to the starboard bank.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

2. Bank Suction and Sheer. The phenomenon of a ship encountering bank suction in a narrow channel is well understood and well documented, and is frequently experienced by pilots in the Sabine-Neches Waterway, particularly on exiting a bend. However, navigating the vessel to avoid being either set against the bank on the suction side, or having it sheer across to the other side of the channel requires shiphandling skill and timing. The EAGLE OTOME was favoring the port side of the channel on exiting Missouri Bend, which is a bend to the right for inbound ships. This caused bank suction to develop on the ship's port quarter, drawing her port quarter into the port side of the channel. In order not to be set against the port bank, the first pilot ordered a Hard Starboard command and a Half Ahead engine order. As described in testimony by the pilots, the president of the Sabine Pilot Association and the master of EAGLE OTOME, fully loaded tankships often take a hard rudder command to start swinging, but it requires a full rudder against the swing for some time to break or stop the swing. The sheer may also have been slightly amplified by a slight flood tide that would have pushed more on the vessel's stern in the outside of the bend.

3. The first pilot made a planning error in failing to avoid bank suction at the exit to Missouri Bend and then did not adequately respond to the bank suction and sheer as result of an execution error. He followed a rule, or heuristic, in responding to the sheering of the tankship by applying rudder and additional engine RPM, but failed to apply these techniques in the right time or magnitude, and as a result, the ship did not steady up on a course in the channel following the first sheer.

Organizational Factors

4. Organizational Factors result from decisions made regarding oversight, training and resources that create Latent Unsafe Conditions that allow the threat to progress. Organizational Factors may include specific decisions, such as the content of a training program, or may create a climate, such as an emphasis on authority that may inhibit communications.

5. Organizational Climate. The lack of oversight by the Jefferson and Orange County Board of Pilot Commissioners and Sabine Pilots Association contributed to a poor safety culture and a climate of independence and overconfidence in shiphandling skills on the part of the pilots. The Board has specific regulatory authority to investigate casualties involving pilots, but their failure to do so over two decades, and the emphasis on the absence of collisions between two ships piloted by Sabine Pilots likely helped foster overconfidence in the individual pilots' skill and emergency shiphandling ability. Overconfidence in his shiphandling skill contributed to the failure of the first pilot to abandon the heuristic of hard rudder and more engine RPMs when the sheering became more severe each time and the ship didn't steady on a course in the channel.

6. Oversight: Medical Fitness. The oversight of the first pilot's medical fitness was not performed by the Jefferson and Orange County Board of Pilot Commissioners, which instead relied solely on the Coast Guard system of annually reviewing pilot physicals under licensing requirements. As a result, the Board made no evaluation of the first pilot's mental and physical fitness to serve as a pilot under his Texas Pilot Commission on 23 January 2010.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

7. The oversight of the medical conditions of the master of the DIXIE VENGEANCE by the Coast Guard was incomplete because the regulations do not require a mariner to submit changes to his/her medical conditions unless he/she had already been granted a medical condition waiver.

8. Oversight: Vessel Traffic. The oversight of the transit of the two vessels and the weather and traffic broadcasts provided by the Port Arthur VTS were within the mission and responsibilities of that organization.

Workplace Factors

9. Workplace Factors result when poor decisions and climate created at the organizational level are not corrected, or when the decisions of first line supervisors create Latent Unsafe Conditions. The absence of work processes and guidance can be a Latent Unsafe Condition.

10. Two Pilot Transit Guidance. As the President of the Sabine Pilots testified, pilots are independent contractors and not employees of the Association. However, the Ship Traffic Protocols dictate two pilots on transits of ships like the EAGLE OTOME. The independent status of pilots created a climate of independent and isolated performance for each pilot and undermined their motivation to work closely together and cooperatively on the bridge of a ship, toward the goal of a safe transit. As a direct result of this independent climate, the guidelines which described the division of labor between the two pilots were ignored. Instead, each pilot took turns shouldering all of the responsibility and tasks associated with having the conn. Before the EAGLE OTOME was in any danger, the second pilot had minimal awareness of the details of the transit including passing arrangements with the DIXIE VENGEANCE. When the vessel was in extremis, the two pilots did not work together cooperatively to resolve it. Aside from three comments during the transit, the second pilot did not aid the first pilot in any way.

11. Pilots as Independent Contractors. Sabine Branch Pilots are not employees of the Pilot Association, nor are they employees of the Board of Pilot Commissioners nor the State of Texas. They are independent contractors who are dispatched through the Association to ships navigating the Sabine Neches Waterway. Their role as independent contractors is exemplified by the fact that neither the Board of Pilot Commissioners nor the Sabine Pilot Association has any performance records for the pilots. This aspect of their relationship with oversight entities undermines a sense of shared responsibility for the overall safety of the waterway, and inhibits any shared concern for the skill and professional development of fellow pilots. The climate which results from the pilot as an independent contractor inhibited the second pilot from alerting other traffic to the deteriorating transit of the EAGLE OTOME as the distance closed to the Port of Port Arthur, the GULL ARROW and the DIXIE VENGEANCE. This climate also contributed to the choice to use a cell phone, rather than a VHF radio to notify the tankship behind EAGLE OTOME of the impending collision. The second pilot testified he chose to use a cell phone to make the call because the first pilot was standing in front of the radio. The second pilot also testified he went out on the starboard bridge wing to make the cell phone call. The VDR however, recorded the cell phone call on the microphones on the bridge, and not on the bridge wing. In addition, the call occurs between the order for Full Astern and the sounding of the EAGLE OTOME's danger signal, indicating the first pilot was out on the port bridge wing. The words used by the second pilot on that call also reflect the lack of a sense of shared responsibility for the transit. His words to the pilot on the tankship behind EAGLE OTOME were, "He's got a

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

big...problem, we're about to hit the Gearbulk. Bye." The climate also raised the risk tolerance of the first pilot so that he did not consider the narrow waterway and the GULL ARROW at the Port of Port Arthur as sufficient justification to take a tug at Texas Island Intersection to reduce the speed and aid in maneuverability of the EAGLE OTOME.

12. Master-Pilot Culture. Also contributing to the breakdown of the master-pilot communication was a culturally influenced disparity between the position of the pilot, and the position of the master, in the perceived responsibility of the pilot for the transit. The pilot had the experience of hundreds of transits in the waterway and issued helm and engine orders. These orders were not discrete pieces of advice to the master, but direct orders to the officers and crew on the bridge. While the master remained responsible at all times for the safety of the vessel, the pilot was the expert in navigating the waterway. This caused the master to falsely assume the pilot would resolve the sheering without any intervention. As a result the master of the EAGLE OTOME failed to engage during the first or second sheers with more deliberate and coordinated attempts to bring the ship under control, and he failed to advise the other vessels on the waterway of the difficulties the ship was experiencing. The assumption created a reluctance by the master to evaluate the negative consequences of the transit and created a false hope that the pilot would recover control despite the progressive worsening of the sheering and the ship's increasingly high rates of turn.

13. Bridge Resource Management. The first pilot and the crew on the bridge of the tankship failed to communicate and work together in the planning and execution of the transit sufficiently to ensure the members of the bridge crew and other vessels were aware of the tankship's situation and increasing risk of allision and collision. Poor communications practices on the part of the first pilot, specifically failing to use the name of the ship and using references not located on the navigation chart, impaired the situational awareness of the EAGLE OTOME bridge crew to the passing arrangements made with the DIXIE VENGEANCE in the vicinity of the Port of Port Arthur and the MLK Bridge. The crew of the EAGLE OTOME, despite being on the bridge and executing the helm and engine orders of the first pilot, were essentially passengers on the ship as the transit deteriorated from Missouri Bend. The first pilot did not discuss with the master and crew, any of the following facts as the transit progressed: The meeting arrangement with the DIXIE VENGEANCE and her barges, the fact that the ship was sheering from well before the bridge, the fact that the hard rudder and engine orders were intended to steady the vessel on course, the fact that the rudder and engine orders were not effective in bringing the ship under control, the need to slow for the ship at the Port of Port Arthur, the fact that the sheering was getting more severe instead of lessening. Even the need to eventually order full astern was never even mentioned, so that at the moment the EOT needed to be set to Full Astern, there was a EOT system fault from the master's action to set the EOT to Nav Full Ahead and hitting the Emergency Stop instead of the Program Bypass. The second pilot, the master and crew on the bridge of the EAGLE OTOME observed the vessel sheer across the channel four times with little discussion with the first pilot on how to remedy the sheering, when to advise other affected traffic, sound the danger signal, let go the anchor or order full astern. The two pilots each testified they hoped the vessel would steady up.

14. Communications on the Sabine-Neches Waterway. The use of local names rather than charted locations by the master of the DIXIE VENGEANCE further impaired the ability of the crew of the EAGLE OTOME to understand they would be meeting the towboat pushing two

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

loaded barges. The VHF radio traffic had a number of vessels making position broadcasts and meeting arrangements, but the broadcast locations of the vessels had little to do with the positions on the chart being actively plotted by the 3rd officer and deck cadet at various points in the transit. Without any discussion from the first pilot that he was making or had made a passing arrangement with a towboat pushing two loaded barges, a flotilla over 670 feet long, the master could not consider that fact as he watched the deteriorating transit of the EAGLE OTOME.

Preconditions

15. Preconditions are a set of qualities of people, machines or the environment that allow a threat to propagate through the system. A precondition is latent by definition and may only have consequences if it is present when an unsafe action takes place. For example, the precondition of not having a life-jacket is only unsafe in the presence of a hazard of deep water.

16. Fatigue. The first pilot's fatigue caused by untreated [REDACTED] and the disturbed sleep from the work-rest period in the 48 hours prior to the casualty could have negatively affected his cognitive function, impairing his ability to ascertain risk and maneuver the vessel to avoid the casualty. Fatigue induced by [REDACTED] and the effects of that fatigue are often not perceived by the individual, so the first pilot was not aware he was impaired. Some [REDACTED] patients have scored in the impaired range in tests that evaluate cognitive function in the areas of attention, concentration and complex problem solving, among others.³⁵ The first pilot was not tested for cognitive function following the casualty, so the contribution of fatigue on his performance could not be measured. However, since he had performed similar transits on hundreds of other occasions, this condition may be an explanation for why this transit had such a different outcome than previous transits. Recovering control of the vessel experiencing bank suction and sheering across a narrow channel involved complex problem solving with the first application of the rule of thumb failed to steady the vessel on course. The first pilot made a number of planning and execution errors that may have been caused by fatigue related impairment. These errors include:

- the failure to avoid the initial bank suction high in Missouri Bend,
- the failure to apply helm and engine commands to recover control of the vessel and avoid the first sheer to starboard below the bridge,
- the failure to perceive or recognize the need communicate with other traffic when the vessel began the second sheer and passed under the MLK Bridge moving to the port side of the channel,
- the failure to perceive the need to begin to attempt alternate solutions to the problem of sheering when the vessel was not brought under control with hard helm orders and increased engine RPMs in two separate attempts,
- the failure to appreciate the consequences of the increasing severity of the sheering,

³⁵ L J Findley, J T Barth, D C Powers, S C Wilhoit, D G Boyd and P M Suratt, "Cognitive impairment in patients with obstructive sleep apnea and associated hypoxemia." *Chest* 1986;90:686-690

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

- the failure to fully employ the expertise of the second pilot in regaining control of the vessel and communicating with the other traffic,
- the failure to communicate with the DIXIE VENGEANCE at any point once the EAGLE OTOME was out of control,
- the failure to recognize the increases in engine RPMs had resulted in an unsafe speed for the transit, and
- the delay in recognizing the vessel was in extremis until the last sheer to port.

17. Channel width. The 400' width of the Sabine-Neches Waterway in the vicinity of the casualty made it more difficult to recover from multiple sheering events because there was little waterway to check the swing of the vessel following a sheer before the vessel experienced bank suction from the other side of the channel. Both Sabine Pilots and the President of the Association testified that vessels the size of EAGLE OTOME commonly experience bank suction even when proceeding at the minimum speed to maintain steerage, however since the channel is only half as wide as the ship is long, severe sheer, with high rates of turn such as the EAGLE OTOME experienced in the transit above the bridge, became far more difficult to recover from since the angle of the vessel crossing the channel became steeper with each sheer, and effectively decreased the sea-room for the ship to be able to steady up on a heading in the channel.

Defenses

18. Defenses are the actions or subsystems designed to prevent unsafe acts from resulting in casualties. For a casualty to occur, the defenses were either absent, they failed or they were defeated. To prevent someone from falling over the side of a vessel, the rail is a defense. For the person to go in the water, the rail may be missing (defense absent), too low or too weak (defense failed), or the person climbed over the rail (defense defeated).

19. Annual Review of Pilot Physicals and Medical Waivers. The Coast Guard system of annual evaluation of medical information was defeated when the first pilot failed to include information on his diagnosis of [REDACTED] and on a changed diagnosis and prescriptions related to [REDACTED] and [REDACTED]. If the Coast Guard National Maritime Center been made aware of the diagnosis of obstructed [REDACTED] and that the first pilot did not use a [REDACTED] machine, additional information would have been required to be submitted in order for the first pilot to be issued a medical waiver and allowed to continue to sail. More importantly, the occupational medical officer at the NMC testified that the waiver would not have been issued if the obstructed [REDACTED] had remained untreated. This would have been due to fatigue and other effects of the condition.

20. Licensing and Qualification. The Jefferson and Orange County Board of Pilot Commissioners' Texas Pilot Commission and the Coast Guard's First Class Pilots licensing programs failed to ensure the first pilot had sufficient skills to regain control of the vessel following multiple sheering events. The commission and license represent a minimally qualified level of performance and do not ensure sufficient skill and experience so that a mariner will

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

recover control of a tankship once it is experiencing multiple sheering events and is out of control.

21. Supervision and Human Error. The master on the EAGLE OTOME did not maintain a position of oversight and authority in the final minutes before the casualty and his focus on the EOT caused him to fail to detect that the starboard anchor had not been deployed at that time. When the master stepped in to take the place of the third officer on the EOT, he testified he did so because he recognized executing the engine orders correctly would be critical. However, because he stepped in for the officer of the watch, he neglected to supervise the other activity on the bridge that he was responsible for, namely the starboard anchor and sounding signals. In the study of human error, the master's actions represent a move from the type of performance that requires thinking and analysis, to the type of performance that requires skills but less thinking. This shift in performance types is common when humans are performing in stressful circumstances.

22. The master of the DIXIE VENGEANCE recognized the position of the EAGLE OTOME was, at first, far to the red side of the channel, and then later, coming across the channel. However, without information coming from the tankship in the way of a broadcast, danger signals, or other activity such as an anchor being released, he underestimated the severity of the lack of control of the EAGLE OTOME and did not slow his vessel when he initiated communications with the tankship to get more information.³⁶

Human Errors

23. Human errors can be generally categorized as either planning errors or execution errors. If it is an execution error, it can be caused by an attention error, where the person remembered the plan but their attention is directed elsewhere, or by a memory failure, where the individual forgets to perform something in the plan. A planning error consists of either a mistake or a violation. The violation occurs when the individual willfully breaks rules in trying to execute the plan, or deliberately changes the plan. The mistake occurs when the person fails to detect and use the correct rule to perform the plan. Different levels of performance yield different types of mistakes. For simple performance a mistake can be the use of a bad rule or the misuse of a good rule. For more complex performance, a mistake can be misusing a rule of thumb or a bias toward an action even when it is not an appropriate solution to the problem.

24. EOT Orders. The master made an execution error when he was operating the EOT at 0933:42 and hit the emergency stop instead of the program bypass on the EOT, negating his engine order of Nav Full. The consequences of this error were actually beneficial overall in that the EAGLE OTOME never increased in speed and did not add additional energy to the allision with the GULL ARROW. The error was not immediately detected though and the result was a delay in the execution of the Full Astern engine order since the fault on the EOT had to be cleared through the conversation between the master and the Engine Control Room at 0934:10 through 0934:28. This was an execution error on the part of the master.

³⁶ U.S. Coast Guard Navigation Rules, Inland Rule 8.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

25. Starboard Anchor. Marine investigators could not determine what caused the delay by the crew member on the bow in releasing the starboard anchor after the order had already been given to remove the bar. The only remaining action was to take off the brake. The OS had a radio and the master's instructions to the OS at minutes 0933:51, 0934:02 and 0934:30, and it is not clear why the order was not executed immediately. However, it remains an execution error on the part of the OS on the bow.

26. Rigidity. Rigidity is a type of rule-of-thumb error and describes an almost overwhelming tendency for a person to apply a solution to a problem that has been successful in the past, even though the circumstances no longer warrant its use.³⁷ The second pilot's suggestion of increased speed above the bridge, using the term "Rapido" was a planning error of rule-based performance. The second pilot had observed all four sheering events according to both his initial statement under oath and the EAGLE OTOME VDR. The sheer above the bridge was the third sheer. However, up until that time, hard to port or hard to starboard helm orders with increases in engine RPMs had not brought the vessel under control. The second pilot failed to adapt to that situation and also neglected to consider the consequences of the increased speed on the other vessels in his view if the ship were not brought under control. The second pilot stated he had experienced sheering events in the past. The same error was made by the master of the EAGLE OTOME when he moved the EOT to Nav Full. The application of additional engine RPM is a good rule of thumb, but it did not bring the vessel under control in the two previous attempts. In addition, as the EAGLE OTOME closed the distance to the Port of Port Arthur, the consequences of speed and the vessel not being under control should have resulted in rejecting the solution of increased engine RPM's.

27. Attention. The personnel on the bridge of the EAGLE OTOME reported they did not hear the two radio broadcasts from the master of the DIXIE VENGEANCE concerning the tankship's position and intention. On reviewing the activities on the bridge at that time, the master was ordering the release of the starboard anchor in a loud and clear voice, and then dealing with the EOT. The first pilot was searching for other options to bring the vessel under control. It is clear the activity on the bridge of the EAGLE OTOME was sufficient to distract the mariners and prevented the radio calls from being heard.

Conclusions

1. The first pilot of the EAGLE OTOME failed to regain control of the vessel when it sheered after experiencing bank suction exiting Missouri Bend. The increases in speed applied to regain control of the vessel following several bank suction events contributed to the vessel proceeding at an unsafe speed. He was unable to control the vessel for 11 minutes until it ultimately allided with the GULL ARROW and collided with the DIXIE VENGEANCE.

2. The bridge crew on the EAGLE OTOME was not aware the EAGLE OTOME had passing arrangements with the DIXIE VENGEANCE, nor the first pilot's intent to slow at the Port of Port Arthur because there was a ship alongside the pier, and therefore was unaware of all of the consequences in not having control of the ship above Missouri Bend.

³⁷ Reason, J., *Human Error*; Cambridge University Press; NY; 2009; 78.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

3. The first pilot of the EAGLE OTOME failed to alter his approach to regaining control of the vessel when several attempts of hard-over helm orders with increases in engine RPMs failed to bring the EAGLE OTOME under control.
4. The first pilot never notified other vessel traffic that the EAGLE OTOME was out of control and did not request the second pilot to notify the downbound tugs until less than two minutes prior to the allision.
5. The master did not notify other vessel traffic of the deteriorating transit of the EAGLE OTOME. Had the master been aware of the meeting situation, he could have initiated communications that would have advised the DIXIE VENGEANCE of their situation and the tow could have slowed and stopped, avoiding the collision with EAGLE OTOME and oil spill.
6. The second pilot never notified the downbound tows that EAGLE OTOME was out of control.
7. The EAGLE OTOME would have allided with the GULL ARROW even if the DIXIE VENGEANCE was not transiting the waterway.
8. There are indications that fatigue from untreated [REDACTED] and work schedule impaired the first pilot's ability to respond adequately to the vessel's transit, accurately assess the increasing risk of collision and the increasing severity of the sheering and take alternate actions, and handle multiple tasks. The degree of the contribution of fatigue to the cause of the casualty and the poor decision making on the part of the first pilot is unknown.
9. The master of the EAGLE OTOME failed to engage with the first pilot to regain control of the ship when it was sheering from bank to bank, for 11 minutes, with increasingly severity. He also failed to sound the danger signal on his vessel to warn the ship at the pier and the DIXIE VENGEANCE of the risk of collision.
10. The second pilot failed to aid the first pilot as the transit of the EAGLE OTOME deteriorated and the risk of collision increased. Specifically, he did not handle radio communications with other traffic nor make effective recommendations to reduce the risk of collision.
11. The decision of the first pilot not to take an escort tug at Texas Island Intersection eliminated an effective mechanism to control the EAGLE OTOME in the transit out of Missouri Bend, through the MLK Bridge and past the Port of Port Arthur.
12. The master of the DIXIE VENGEANCE failed to slow when he first recognized a risk of collision. This error cost as much as seven seconds of astern propulsion. Once full astern was applied on DIXIE VENGEANCE slowed 2.3 knots in 1 minute. While the collision would not have been avoided with this action alone, there may have been sufficiently less energy in the collision that the cargo tank of the EAGLE OTOME may not have been breached by tankbarge KIRBY 30406.
13. There is no evidence that the medical condition or prescription medication taken by the master of the DIXIE VENGEANCE contributed to the casualty.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-NECHES WATERWAY ON 23 JANUARY 2010

14. The master of the DIXIE VENGEANCE could not avoid the collision once the EAGLE OTOME crossed the channel and allided with the GULL ARROW.

15. The severity of the last sheer to port of the EAGLE OTOME, and the inevitability of an allision, initiated a breakdown of the performance of the bridge team and resulted in a series of human errors and missed communications.

16. Though not a contribution to the casualty, both pilots involved in the allision of the EAGLE OTOME with the GULL ARROW and the collision with the barge KIRBY 30406 pushed by the DIXIE VENGEANCE and the 462,000 gallon oil spill, continued to pilot ships as soon as the waterway reopened without further evaluation of physical or mental fitness.

17. There is no evidence of equipment failures contributing to the casualty. The propulsion, steering and navigation systems of the EAGLE OTOME and DIXIE VENGEANCE operated properly.

18. There is no evidence that any act of misconduct, incompetence, negligence, lack of professionalism, and/or willful violation of law committed by any officer, employee, or member of the Coast Guard contributed to the cause of this casualty.

Recommendations

1. That the Jefferson and Orange County Board of Pilot Commissioners undertake a review of reportable marine casualties involving Sabine Pilots and commission a third party audit of the pilot training program and advanced pilot training and enact changes to ensure all Sabine Pilots have sufficient training, guidance and practice in shiphandling, communications and emergency shiphandling skills in narrow waterways such as the Sabine-Neches Waterway.

2. That the Jefferson and Orange County Board of Pilot Commissioners require pilots to use the name of the ship in accordance with 47 CFR 80.331, and locations listed on navigation charts, in bridge-to-bridge communications.

3. That the South East Texas Waterway Advisory Council (SETWAC), with the Port Arthur VTS, develop a consensus agreement that ship names and charted locations be used in communications in the Sabine-Neches Waterway.

4. That the American Pilots Association encourage member associations to establish communications best practices that emphasize the use of vessel names and charted locations in bridge-to-bridge communications.

5. That the Jefferson and Orange County Board of Pilot Commissioners establish continuing education requirements for Sabine Pilots to include Bridge Resource Management on a five year interval.

6. That the American Pilots Association educate their members on the effects of untreated sleep apnea on fatigue and cognitive ability, and the general effects of rotating day and night shift schedules on pilot fatigue and human performance.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

7. That the Coast Guard pursue regulations to require mariners notify the Coast Guard National Maritime Center when they have a change in their medical condition, even if they are not currently operating under a medical waiver, so that an evaluation can be made of their fitness to consider to serve under their license.

8. That the Coast Guard National Maritime Center amends their administrative procedures to receive signed receipts for medical waivers prior to forwarding to a mariner, the license or document covered by that waiver, and apply expiration dates to medical waivers for pilots to ensure they receive and maintain the most current waiver applicable to the license under which they are operating.

9. That the Coast Guard explore adding a requirement of an evaluation of mariners for sleep apnea to mariner quintennial physicals, and for pilots, each physical associated with their license application or renewal.

10. That the Sabine Pilots Association revisit the guidelines on two pilot transits and delineate roles and responsibilities between the two pilots that would serve to afford the masters of piloted ships the benefit of the expertise of two Sabine Pilots on the bridge instead of one pilot at a time at various times in the transit.

11. That the Sabine Pilots Association provide to vessel masters, any applicable protocols and guidelines related to two pilot transits.

12. That SETWAC establish consensus, risk-based criteria for the use of escort tugs for loaded deep draft vessels for the Sabine-Neches Waterway, in particular the 12-mile portion shared by the Sabine Ship Channel and the Gulf Intracoastal Waterway.

13. That SETWAC, with the Army Corps of Engineers, explore the costs and benefits of changes to the waterway to allow for more room for the navigation of deep draft vessel traffic and barges that may include widening the channel or creating a barge shelf along the 12 miles of the Sabine-Neches Waterway shared by the Sabine Ship Channel and the Gulf Intracoastal Waterway to reduce the risk of ships colliding with tows.

14. That AET, LTD, owner and operator of the EAGLE OTOME, review this casualty and emphasize the importance of Bridge Resource Management with their masters and navigation watch personnel.

15. That the Sabine Pilots Association develop and implement administrative and dispatch procedures that would remove a pilot involved in a serious marine incident³⁸ from the board of pilots on watch until an evaluation of mental and physical fitness to pilot is completed by the Jefferson and Orange County Board of Pilot Commissioners or other appropriate entity.

16. That the American Pilot Association engage with their members and explore best practices for placing pilots on an administrative status that permits an evaluation of the pilot for mental and physical fitness to pilot ships, by an appropriate authority, prior to returning to pilot duties.

³⁸ As defined by 46 CFR 4.03-2.

Subj: ALLISION OF THE T/V EAGLE OTOME WITH THE M/V GULL
ARROW AND SUBSEQUENT COLLISION WITH T/B KIRBY 30406, PUSHED
BY THE UTV DIXIE VENGEANCE, AND OIL SPILL IN THE SABINE-
NECHES WATERWAY ON 23 JANUARY 2010

Administrative Recommendations

1. That this casualty investigation be closed.

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