



UNITED STATES COAST GUARD

REPORT OF INVESTIGATION INTO THE ELECTROCUTION OF A LICENSED THIRD ENGINEER ONBOARD THE S/R WILMINGTON OFFSHORE GALVESTON, TEXAS

ON 01/07/2009



MISLE ACTIVITY NUMBER: 3390690



16732

MAY 09 2011

**REPORT OF INVESTIGATION INTO THE ELECTROCUTION OF A LICENSED
THIRD ENGINEER ONBOARD THE S/R WILMINGTON OFFSHORE GALVESTON,
TEXAS, ON JANUARY 7, 2009**

ACTION BY THE COMMANDANT

The record and the report of this investigation have been reviewed. The record and the report, including the findings of fact, analysis, conclusions, and recommendations are approved subject to the following comments. This Commandant's Action document updates and supersedes the original Commandant's Action dated October 21, 2010.

COMMENTS ON THE FINDINGS OF FACT

The Findings of Fact included in the report is approved subject to the following comments:

Findings of Fact #20/21 (Page 12): The electrical breaker being replaced was not equipped with an undervoltage release function. However, the replacement breaker was equipped with an undervoltage release. While the model number and operational specifications of the replacement breaker matched those of the damaged breaker, it is unknown whether or not the distribution panel in which this breaker was to be installed was set up to receive the wire connections for the undervoltage release. First Assistant Engineer [REDACTED] and Third Assistant Engineer Erickson did not intend to remove the undervoltage capabilities of the new breaker rather they were in the process of testing it prior to installing the new breaker in the electrical distribution panel for the engine room supply fan. While the replacement breaker equipped with the undervoltage release could be made to work as a suitable replacement for the damaged breaker, it was not the correct replacement breaker for the intended application.

Finding of Fact #28 (Page 14): The red warning placard shown in Figure 8 reads as follows: "480 VOLTS AC DE-ENERGIZE BEFORE OPENING DOORS." The testing panel has three access/maintenance doors to which this warning placard refers (See Figure 6, page 12). This placard may not have referred to the 480V receptacle cover as detailed in the report as no other testing receptacles and corresponding switches on the panel were marked with similar warnings. The placard in question was installed in a location that may have caused confusion regarding what it applied to. Coast Guard investigators were told by members of the vessel's crew that they believed the placard referred to the 480V receptacle. Nevertheless, the breaker servicing the 480V receptacle should have been verified to be in the OFF position prior to utilizing the receptacle. No separate instructions should have been required or expected for engineers on the S/R WILMINGTON to secure the 480V breaker prior to utilizing the receptacle as this would be considered part of their basic knowledge of their position as licensed engineers.

Finding of Fact #30 (Page 14): An electrical breaker that has tripped results in current and voltage being isolated from the circuit being serviced by that breaker. If the 480V electrical breaker located on the test panel was in the tripped position as reported by the First Assistance Engineer, Mr. [REDACTED] there would have been no voltage or current available at the corresponding 480V receptacle unless the breaker was faulty. This test panel was tested by third party engineers following the casualty and determined to be operating normally. As a result the 480V breaker on the test panel must have been in the ON position at the time of the casualty.

Finding of Fact #93 (Page 21): On December 17, 2009 the U.S. Coast Guard's Eighth District Commander determined SeaRiver Maritime's arguments in its appeal of the OCMI's determination of a Safety Management System major non-conformity were not supported and that a Safety Management System major non-conformity existed prior to the electrocution of Christopher Erickson onboard the S/R WILMINGTON on January 7, 2009.

Comment: Subsequent to the determination by the Eighth District Commander, SeaRiver Maritime submitted an appeal of that determination to Commandant (CG-543) in accordance with 46 CFR Subpart 1.03 – Rights of Appeal. On October 19, 2010, Commandant (CG-543) issued its determination, that while the facts and evidence support that non-conformance with electrical safety procedures existed onboard the S/R WILMINGTON prior to and at the time of the casualty, it does not support that a major non-conformity existed (33 CFR 96.120). As a result, SeaRiver Maritime's appeal was granted.

COMMENTS ON CAUSAL ANALYSIS

The Analysis included in the report is approved subject to the following comments:

First paragraph on page 24: Prior to issuing the determination of a major non-conformity on May 27, 2009, the OCMI's decision was reviewed and approved by Sector Houston-Galveston, the Office of Vessel Activities (CG-543), the Office of Quality Assurance and Traveling Inspectors (CG-546), and the Coast Guard's Liaison to Authorized and Recognized Classification Societies.

Comment: The decision to issue a major non-conformity was made solely under the authority of the Officer in Charge, Marine Inspection (OCMI). There are no regulations, policies, or procedures that require the consent of any other Coast Guard party before the issuance of an OCMI decision. So, while in this case the OCMI consulted with certain parties within the Coast Guard organization, their review and advice was not, nor should it have been considered, to have been a comprehensive review resulting in an "approval" of the OCMI's decision to issue a determination of major non-conformity.

COMMENTS ON CONCLUSIONS

The conclusions included in the report are approved subject to my comments:

Conclusion 3: A major non-conformity existed in the S/R WILMINGTON's Safety Management System prior to this marine casualty.

Comment: After having requested reconsideration from the Officer in Charge, Marine Inspection (OCMI), and appealing to the Eighth District Commander, SeaRiver Maritime submitted an appeal of the OCMI's determination of a Safety Management System major non-conformity to Commandant (CG-543) in accordance with 46 CFR Subpart 1.03 – *Rights of Appeal*. On October 18, 2010, Commandant (CG-543) issued its determination, that while the facts and evidence support that non-conformance with electrical safety procedures existed onboard the S/R WILMINGTON prior to and at the time of the casualty, it does not support that a major non-conformity existed. As a result, SeaRiver Maritime's appeal was granted.

Conclusion 5: The existing Alternate Compliance Program does not provide adequate oversight of Authorized Organizations and is not completely effective in achieving one of the Coast Guard's primary missions of preventing the loss of life.

Comment: We do not concur with this conclusion. In the approximately fifteen years since its inception, the Alternate Compliance Program (ACP) has proved to be a functioning and effective regulatory program. Even so, as we do with every Coast Guard program, we continually seek for ways to improve its efficiency and effectiveness. As an example, a project is underway to develop a comprehensive performance-based monitoring scheme for the ACP in order to more objectively evaluate the performance of companies, vessels, and classification societies in a continuous, transparent way to ensure they are meeting their responsibilities and achieving the intent of the program.

ACTION ON RECOMMENDATIONS

Recommendation 1: It is recommended that Occupational Safety and Health Administration electrical safety rules be adopted to improve electrical safety procedures, installations and operations onboard U.S. inspected vessels.

Action: We do not concur with this recommendation. We believe the proper implementation of Safety Management Systems required by the International Safety Management (ISM) Code and 33 CFR Part 96, in conjunction with the electrical engineering standards in 46 CFR Subchapter J establish an adequate level of electrical safety. As documented in this investigation, it was not a lack of proper rules or procedures that were the issue (the Safety Management System implemented on the vessel included proper procedures for electrical safety) but a failure to apply those procedures and basic electrical safety practices to operations in the electrical workshop.

Recommendation 2: It is recommended that the U.S. Coast Guard revise guidance to Authorized Organizations and the maritime industry regarding the implementation and auditing of Safety Management Systems onboard U.S. inspected vessels. The guidance should clearly outline for the maritime industry and Authorized Organizations what actions, conditions and incidents constitute Safety Management System non-conformities and major non-conformities; the required scope of third party audits; marine casualty reporting requirements to third parties, and required follow-up audits and actions to address the causes of marine casualties.

Action: We concur with the intent of this recommendation. We believe the guidance provided to Authorized Organizations and the maritime industry regarding implementation and oversight of the International Safety Management (ISM) Code is comprehensive and generally adequate. However, as a result of this investigation we have identified the following subject areas in our policies that will be reviewed and updated:

1. Identifying and classifying major non-conformities.
2. Roles and responsibilities between Officers in Charge, Marine Inspection (OCMIs) and Authorized Organizations/Recognized Organizations (AO/RO) related to marine casualty reporting requirements and their relationship to third parties, as well as clarification regarding Coast Guard requirements of third parties as a result of a marine casualty.

Recommendation 3: It is recommended that the U.S. Coast Guard require companies participating in the Alternate Compliance Program to immediately report deaths and injuries onboard their vessels to their authorized classification societies and to subsequently request an audit of the Safety Management System to determine if non-conformities contributed to the loss of life or injury.

Action: We concur with the intent of this recommendation. We believe the existing regulatory requirements for marine casualty reporting and the Coast Guard's authority to require ISM audits, conduct periodic oversight re-examinations following a marine casualty described in policy are generally sufficient. However, we will review and update our policy regarding the roles and responsibilities between Officers in Charge, Marine Inspection OCMI and Authorized Organizations/Recognized Organizations (AO/RO) to include clarification of marine casualty reporting requirements and their relationship to third parties and provide clarification regarding Coast Guard requirements of third parties as a result of a marine casualty.

Recommendation 4: It is recommended the U.S. Coast Guard re-examine the Alternate Compliance Program to ensure the currently accepted system of third party oversight and the Coast Guard's implementation of the program provides an equivalent level of safety as a full regulatory vessel inspection.

Action: We concur with the intent of this recommendation. In the approximately fifteen years since its inception, the Alternate Compliance Program (ACP) has proved to be a functioning and effective regulatory program. Its system of third party oversight and our implementation of the program provide an equivalent level of safety to that provided by the corresponding regulatory inspection regime. So, while we will continually seek for ways to improve ACP's efficiency and effectiveness, we do not believe a detailed re-examination of the program for the specific purposes described in this recommendation is necessary.

Recommendation 5: It is recommended that the U.S. Coast Guard provide clear direction to Authorized Organizations requiring the inspection and auditing of installations that require crewmembers to work with hazards identified by the approved Safety Management System.

Action: We concur with the intent of this recommendation. We believe, when appropriate, surveys and audits conducted by Authorized Organizations (AOs) and/or Recognized

Organizations (ROs) should generally include evaluation of a Safety Management System's (SMS) coverage of key shipboard operations including those involving installations that require crewmembers to work with hazards identified by the approved SMS. As such, we will update the guidance provided to AOs/ROs in Navigation and Vessel Inspection Circular (NVIC) 02-95 to recommend this topic is considered when they carry out surveys and/or audits. However, due to the variety of factors that determine the nature and scope of individual surveys and audits carried out by AOs/ROs, we do not intend to issue prescriptive guidance that requires inclusion of specific installations in surveys and/or audits.

Recommendation 6: It is recommended that the U.S. Coast Guard fully train and qualify marine inspectors to provide adequate oversight of Authorized Organizations and third party auditors.

Action: We concur with this recommendation. As the U.S. agency responsible for verifying compliance with the requirements of the International Safety Management (ISM) Code and for proper oversight of organizations acting on its behalf, we believe the U.S. Coast Guard should implement the same or an equivalent standard of competency for its personnel who perform ISM Code oversight and verification activities. We are working on revisions and updates to our requirements for training, experience and certifications/qualifications for Coast Guard personnel assigned to conduct ISM Code oversight and verification activities, as well as re-introducing ISM Code-related training to the appropriate Coast Guard basic and advanced level marine inspection training courses.



KEVIN S. COOK
Rear Admiral, U.S. Coast Guard
Director of Prevention Policy

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ENCLOSURES

- 1. S/R WILMINGTON Vessel History
- 2. Standards for Training, Certification, and Watchkeeping for Seafarers (STCW)
- 3. Electrical Regulations and Requirements Gap Analysis
- 4. S/R WILMINGTON Vessel Crew List
- 5. Approved Electrical Test Procedures
- 6. U.S. Coast Guard Marine Safety Alert on Electrical Shock Hazards, April 16, 2009
- 7. Brooks and Jackson Electrical Equipment Inspection Report, dated May 20, 2009
- 8. Owens Forensic Engineering Final Report of Observations, Findings and Conclusions, dated May 26, 2009
- 9. U.S. Coast Guard Determination of a Safety Management System Major Non-Conformity, dated May 27, 2009
- 10. SeaRiver Maritime, Inc. Request for Reconsideration of the U.S. Coast Guard's Determination of a Safety Management System Major Non-Conformity, dated June 24, 2009
- 11. SeaRiver Maritime, Inc. Response Activities Post Erickson Casualty, dated June 25, 2009
- 12. U.S. Coast Guard Response to SeaRiver Maritime's Request for Reconsideration of a Safety Management System Major Non-Conformity, dated July 14, 2009
- 13. SeaRiver Maritime, Inc. Requests for Extension of Time to Appeal Major Non-Conformity Determination, dated July 28, 2009 and August 24, 2009, and Appeal of Major Non-Conformity Determination, dated September 10, 2009
- 14. U.S. Coast Guard's Response to SeaRiver Maritime's Appeal of Major Non-Conformity Determination, dated December 17, 2009

I. EXECUTIVE SUMMARY

On January 7, 2009, at approximately 1610 (CST), the United States flagged chemical Tank Ship S/R WILMINGTON was at anchor in the Galveston Fairway Anchorage. The anchorage is located at the position 29° 15.9' Northern Latitude and 094° 30.4' Western Longitude. The S/R WILMINGTON was waiting to commence an inbound transit to the Vopak Facility in Bayport, Texas. The original scheduled time for the transit was 2200 local. The Vopak Facility did not have an available dock, delaying the vessel's transit until berthing became available.

The First Assistant Engineer [REDACTED] and two Third Assistant Engineers, Christopher Erickson and [REDACTED] were in the ship's electrical workshop. [REDACTED] and Christopher Erickson were to conduct an electrical function check for a circuit breaker. [REDACTED] was in the workshop due to work on an unrelated project. The function check was of the solenoid that provides the undervoltage release functionality of the breaker. When the supply voltage to the solenoid associated with the undervoltage release functionality drops to a preset value, the solenoid causes the breaker to open, shutting down and protecting the equipment that the breaker feeds. The breaker must then be manually closed but only once a certain voltage is reached.. The solenoid receives its power from two blue leads.

The engineers decided to use a "makeshift" electrical test lead to connect the power source to the circuit breaker. This makeshift test lead, or "pigtail," consisted of a four (4) prong plug, a six (6) foot insulated cord, and three bare exposed wires. The three bare wires functioned as the working end conductors to connect power from an electrical test panel in the electrical workshop to the solenoid. The wires of the test lead were to be connected to the wires of the solenoid. The test lead was plugged into the electrical test panel prior to the connection.

Christopher Erickson picked up the aforementioned electrical test lead while it was energized and before it was connected to the circuit breaker to be tested; his hands then made contact with the bare exposed wire working end conductors. The contact with the bare exposed wires of the makeshift test lead caused Christopher Erickson to be electrocuted. The crew of the S/R WILMINGTON subsequently attempted to resuscitate Christopher Erickson using Cardiopulmonary Resuscitation (CPR), an Epinephrine I.V., and an Automatic Emergency Defibrillator (AED). All attempts to resuscitate him were unsuccessful. Christopher Erickson was evacuated by a United States Coast Guard helicopter to Memorial Hermann Hospital in Houston, Texas. He was pronounced deceased by hospital physicians at 1830 (CST).

The U.S. Coast Guard investigatory and causal analysis process revealed a gap or latent unsafe condition in all five (5) of the main system elements.

1. The Organization Element had latent unsafe conditions in missing instructions for equipment usage and a Safety Management System major non-conformity onboard the S/R WILMINGTON, inadequate Safety Management System oversight by the American Bureau of Shipping, and absent regulations and inadequate Authorized Organization oversight by the United States Coast Guard.

2. The Workplace Element had latent unsafe conditions in supervision and operations. Specifically, managers allowed crewmembers to work in the presence of unnecessary hazards and incorrect data was shared among the engineers working in the electrical workshop.

3. The Preconditions Element had a latent unsafe condition due to the miscommunications between personnel working together and the use of improper equipment.

4. The Production Factors Element included a human error related latent unsafe condition as personnel were not following safety placards.

5. Finally, defenses were removed and supervisory oversight was inadequate. For example, the engineers used a “makeshift” electrical test lead with the designed insulated alligator clips removed. Additionally, defenses, such as briefings, training and personal protective equipment, were missing or inadequate.

The causal analysis of this personnel casualty led the investigation team to the following five (5) conclusions.

1. The First Engineer, Mr. [REDACTED], violated the ship’s rule by not following the instructions on the placard above the 480 volt switch on the Electrical Test Panel; not conducting a new job hazard analysis after changing personnel; not wearing personal protective equipment; and not communicating a hazard to other personnel in the electrical workshop under his supervision.

2. The Third Assistant Engineer, Mr. Christopher Erickson, placed himself in a hazardous situation by picking up the electrical test lead (not treating the circuit as live); not ensuring a proper job hazard analysis was conducted; and not wearing personal protective equipment.

3. A major non-conformity existed in the S/R WILMINGTON’S Safety Management System prior to this marine casualty. Identifiable deviations from the International Safety Management Code and Safety Management System which posed a serious threat to personnel existed onboard the S/R WILMINGTON and these deviations required immediate corrective action.

4. The U.S. Coast Guard does not have regulations that specifically require electrical safe work practices or personal protective equipment to protect mariners against electrical hazards.

5. The existing Alternate Compliance Program does not provide adequate oversight of Authorized Organizations and is not completely effective in achieving one of the Coast Guard's primary missions of preventing the loss of life.

II. FINDINGS OF FACT

Undertaken pursuant to the U.S. Coast Guard's Investigative authorities under Title 46, United States Code 6301, this investigation documents the Coast Guard's findings regarding the electrocution and subsequent death of Third Assistant Engineer Christopher Erickson onboard the S/R WILMINGTON.

This investigation was conducted in accordance with Coast Guard Marine Safety Manual Volume V (MSM) guidance. All citations from the MSM in this report of investigation will be presented with the page number, followed by the appropriate section.

Throughout the course of this investigation, Coast Guard Marine Safety Unit Galveston (MSU) investigators interviewed over thirty (30) people during over ninety (90) hours of interviews. The team reviewed over 538 evidentiary documents totaling over 2,430 pages. The investigations team also collected one item of physical evidence. Additionally, MSU investigators received input and guidance from a wide range of both internal and external expertise and resources.

Internally, MSU investigators received input and guidance from the following offices:

- U.S. Coast Guard's Marine Safety Center
- The National Maritime Center
- Coast Guard Liaison to Authorized and Recognized Classification Societies
- Office of Domestic Vessel Activities (CG-543)
- Office of Investigations and Casualty Analysis (CG-545)
- Office of Health and Safety (CG-11)
- Regional Exam Center New Orleans
- Regional Exam Center Houston
- Coast Guard Air Station Houston
- Coast Guard Sector Houston-Galveston
- Coast Guard Sector Hampton Roads
- Coast Guard Eighth District Prevention and Legal Offices
- Atlantic Area Prevention and Legal Offices
- U.S. Coast Guard Office of Archives
- U.S. Coast Guard Academy
- U.S. Coast Guard Suspension and Revocation National Center of Expertise
- U.S. Coast Guard Marine Casualty Investigation National Center of Expertise

Externally, MSU investigators received input and guidance from the following offices, agencies and institutions:

- Occupational Safety and Health Administration (OSHA)
- Naval Safety Center
- American Bureau of Shipping (ABS)
- U. S. Merchant Marine Academy
- Massachusetts Maritime Academy
- General Electric (GE)
- Phillips Medical
- Harris County Medical Examiner
- Memorial Hermann Hospital
- University Services Medical Review Offices
- SeaRiver Maritime, Inc.; Exxon-Mobil
- Private Legal Offices
- Professional Engineers

Coast Guard investigators researched and subsequently analyzed all evidence in an effort to conduct a thorough investigation. This report follows the U.S. Coast Guard Report of Investigation (ROI) recognized format and U.S. Coast Guard Marine Information for Safety and Law Enforcement (MISLE) terminology. It contains the findings of fact, the methodology of analysis, the conclusions drawn from the analysis, and recommendations to prevent the reoccurrence of such casualties.

The following data is a list of ships particulars from the U.S. Coast Guard Marine Information for Safety and Law Enforcement (MISLE) database:

| | |
|-------------------------------|--|
| Vessel Name: | S/R WILMINGTON |
| Flag: | UNITED STATES |
| Vessel Identification Number: | 658494 |
| Call Sign: | WBVZ |
| Status: | UNDAMAGED |
| Role: | INVOLVED IN A MARINE CASUALTY |
| Vessel Class, Type, Sub-Type: | TANK SHIP, CHEMICAL TANK SHIP, OIL and CHEMICAL TANK SHIP |
| Gross Tonnage (GRT): | 27,508 |
| Net Tonnage (NRT): | 18,255 |
| Deadweight Tons: | 42,000 |
| Length: | 617.2 |
| Home/Hailing Port: | WILMINGTON, DELAWARE UNITED STATES |
| Keel Laid Date: | 12/14/1982 |
| Delivery Date: | 07/12/1984 |
| Place of Construction: | AVONDALE, LOUISIANA UNITED STATES |
| Builder Name: | AVONDALE SHIPYARDS, INC |
| Propulsion: | DIESEL DIRECT |
| Horsepower: | 17,000 |

| | | |
|-------------------------------|---|-----------------------|
| Master: | [REDACTED] | |
| Classification Society: | AMERICAN BUREAU OF SHIPPING | |
| Owner: | SEARIVER MARITIME | SEARIVER MARITIME |
| | 800 BELL STREET | SRM-EMB-4.096 |
| | SRM-EMB-4.115 | 800 BELL STREET |
| | HOUSTON, TEXAS, 77002 | HOUSTON, TEXAS, 77002 |
| | UNITED STATES | UNITED STATES |
| Operator: | SEARIVER MARITIME, INC | |
| Inspection Subchapter: | O and D | |
| Most Recent Vessel Inspection | 3146607, 08/07/2007 | |
| Activity: | | |
| Current Certificate of | ISSUED ON 08/21/2004 (PRIOR TO MARINE CASUALTY) | |
| Inspection: | BY MARINE INSPECTION DETACHMENT SINGAPORE | |

The following is a chronological list of the facts leading up to the marine casualty found during the investigation. Each finding of fact is supported by evidence. The corresponding piece of evidence is identified by an Evidence Control Number (ECN) or a description of the evidence.

All times entered are local. All interviews were transposed. The interviews were conducted in accordance with the U.S. Coast Guard Marine Safety Manual's Software, Hardware, Environment, and Liveware (SHEL) Factor Model. The SHEL Model analyzes how individuals involved in a marine casualty interact with manuals and policies (software), equipment and machinery (hardware), climate and visibility conditions (environment), and other human beings (liveware).

1. The S/R WILMINGTON is a 617.2-foot chemical tanker. The vessel is owned and operated by SeaRiver Maritime, Inc. a subsidiary of Exxon-Mobil. The ship is certificated to carry cargo under 46 Code of Federal Regulations, Subchapters D and O. The construction of the vessel began on December 14, 1982, at Avondale Shipyard in New Orleans, Louisiana, and the vessel was delivered for service on July 12, 1984. The vessel's plans for construction were submitted to and reviewed by United States Coast Guard Marine Safety Center (ECN 3390690-35 [REDACTED]).



Figure 1: Photograph of Tank Vessel S/R WILMINGTON

2. On January 7, 2009, the S/R WILMINGTON was at anchor in the Galveston Bravo Anchorage and awaiting the availability of a berth at the Vopak Facility in Bayport, Texas (Figure 2). The S/R WILMINGTON was originally scheduled to deliver its cargoes of Paraxylene and ExxSol D-40 on January 8, 2009 to the Vopak Facility (ECN 3390690-16-[REDACTED]).

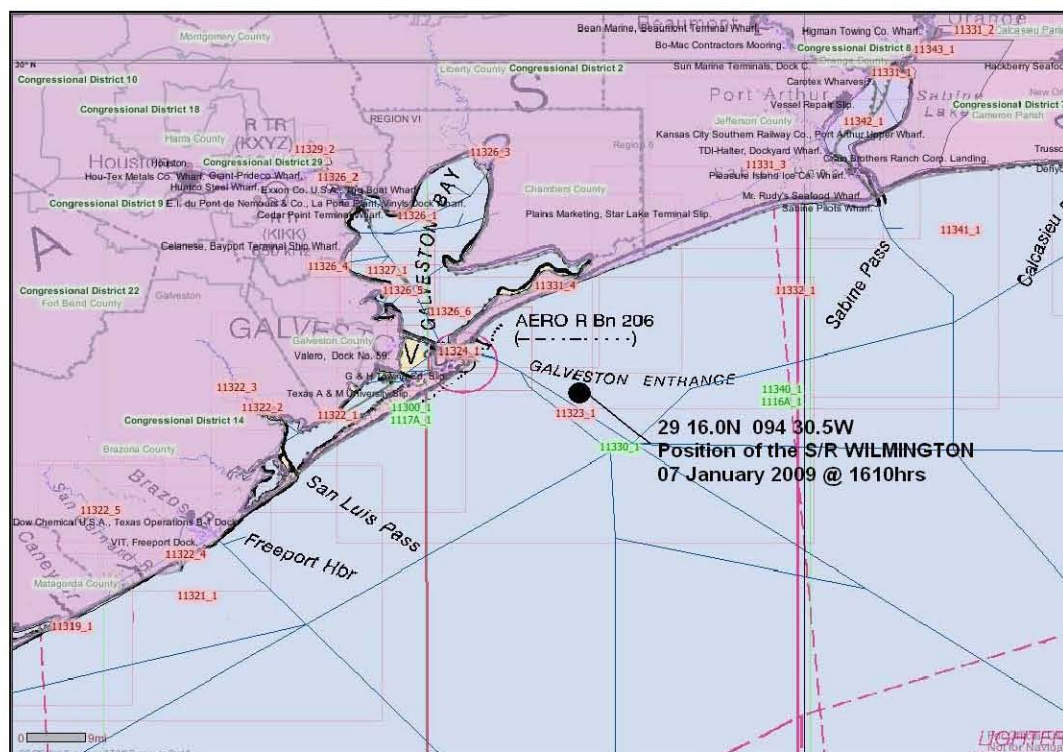


Figure 2: Galveston Offshore Anchorage

3. On January 7, 2009, the S/R WILMINGTON had 26 personnel on board (ECN 3390690-36-[REDACTED]).
4. At 1000, the crew of the S/R WILMINGTON conducted security drills, an emergency oil spill response drill, and then returned to regular ship's work (ECN 3390690-16-[REDACTED]).
5. At 1300, the engineering staff conducted a regular scheduled break. During the break, the personnel conducted a standard brief of ship's work. After the break, engineers were planning to look inside a diesel fuel oil supply tank to inspect it for leaks or damage. The engineers were not planning to enter the tank, but to look into the tank through a hatch on the tank (ECN 3390690-16-[REDACTED]).
6. During the break, Chief Engineer [REDACTED] requested the engine room supply fan speed be increased. The increased fan speed would allow more air to pass over the tank's top and improve the air quality for the individuals looking in the tank (ECN 3390690-31-[REDACTED], ECN 3390690-34-[REDACTED]).
7. As the fan speed was increased, the circuit breaker for the fan failed. The circuit breaker that failed was located in the fan space one deck above the engine room onboard

the S/R Wilmington. The circuit breaker, which supplied the motor controller for the fan, was in an electrical distribution panel positioned on a bulkhead and was not equipped with an under-voltage release solenoid. The breaker failed due to a loose lead connection from a power supply to the circuit breaker. An inspection of the loose lead and circuit breaker revealed the circuit breaker was damaged and needed to be replaced (ECN 3390690-31-██████████ ECN 3390690-34-██████████).

8. ██████████ requested Second Engineer ██████████ check the breaker and diagnose the fan's problem. ██████████ found and inspected the failed breaker and then requested the assistance of ██████████ to remove the failed circuit breaker (ECN 3390690-34-██████████).

9. At 1330, ██████████ filled out and signed a work permit for the removal of the circuit breaker. In the "Description of the Work to be Performed" section, the work permit read, "inspect damage MEG motor and inspect contacts." The work permit was used for the removal of the circuit breaker and evaluation of the causes for the failure (ECN 3390690-08-██████████).

10. At 1350, the work permit was signed and the engine room supply fan electrical system was "locked out and tagged out" in accordance with S/R WILMINGTON's Safety Management System Lockout/Tagout procedures that are a part of the ship's Safety Management System (ECN 3390690-08-██████████).

11. At 1352, ██████████ and ██████████ removed the circuit breaker and took the breaker to the ship's electrical workshop for further investigation. The electrical workshop is located one compartment aft of the engine room main control room on the starboard side. The electrical workshop is located three (3) decks below the main deck and adjacent to the main machinery space. Figure 3 depicts the workshop's location on the vessel (ECN 3390690-34-██████████).

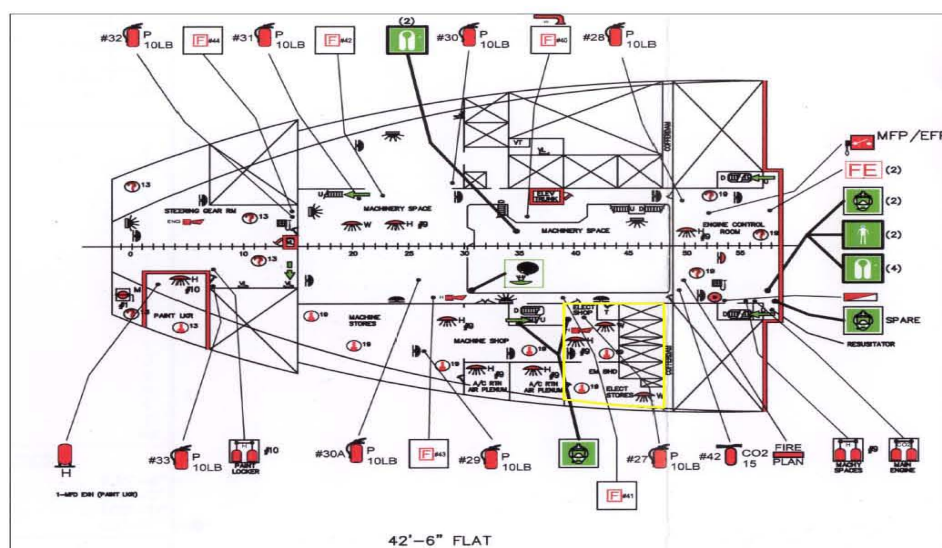


Figure 3: Depiction of Electrical Workshop location onboard the S/R WILMINGTON (workshop highlighted in yellow)

12. At 1500, during the examination of the circuit breaker, [REDACTED] reached his work hour time limit. Based on S/R WILMINGTON's work rest policy, it was required that [REDACTED] stop work (ECN 3390690-34-[REDACTED]).

13. When [REDACTED] stopped work, [REDACTED] took over the further investigation and examination of the failed circuit breaker (ECN 3390690-34-[REDACTED]).



Figure 4: Photograph of Damaged Circuit Breaker

14. During the evaluation of the damaged circuit breaker (Figure 4), [REDACTED] selected Christopher Erickson to assist him with the further investigation and examination of the failed circuit breaker. A new work permit was not filled out for [REDACTED] and Christopher Erickson's participation (ECN 3390690-34-[REDACTED]).

15. At 1505, [REDACTED] and Christopher Erickson were in the electrical workshop working at the electrical test panel workbench (Figure 5). [REDACTED] entered the electrical workshop (ECN 3390690-33-[REDACTED] ECN 3390690-34-[REDACTED]).

16. [REDACTED] was not participating in the further investigation and examination of the failed circuit breaker. He was working on a welding project in the ship's welding shop. He entered the electrical repair shop to wait while his weld cooled (ECN 3390690-34-[REDACTED]).

******* Crewmembers directly involved in the marine casualty*******

[REDACTED]: A graduate of the United States Merchant Marine Academy who had 28 years of experience. [REDACTED] is a licensed Chief Engineer and has spent his entire career as an employee of Exxon/SeaRiver Maritime. At the time of the casualty, [REDACTED] was working as a First Assistant Engineer onboard the S/R WILMINGTON and had been onboard for 47 days.

Christopher Erickson: A graduate of Massachusetts Maritime Academy who had 1 year and 6 months experience as a licensed Third Assistant Engineer. Christopher Erickson had spent his entire career as an employee of SeaRiver Maritime. At the time of the casualty, Christopher Erickson was working as a Third Assistant Engineer onboard the S/R WILMINGTON and had been onboard for 48 days.

██████████ A graduate of Massachusetts Maritime Academy who had 6 months experience as a licensed Third Assistant Engineer. ██████████ had spent his entire career as an employee of SeaRiver Maritime. At the time of the casualty, ██████████ was working as a Third Assistant Engineer and had been onboard for 52 days.

17. After evaluation by ██████████ and Christopher Erickson, it was decided the circuit breaker was irreparable and a new circuit breaker was needed to restore the engine room supply fan. S/R WILMINGTON's Safety Management System "Instructions for Work Permits" Section 1, Bullet 3 states, "If there are any changes in work scope and/or time frame from the original permit, a new permit must be issued, reviewed and signed by all of those involved." A new work permit was not filled out (ECN 3390690-34-██████████).

18. Christopher Erickson retrieved a new circuit breaker from the storage area adjacent to the electrical workshop. After retrieving the new breaker, Christopher Erickson returned to the electrical test panel workbench (Figure 5) (ECN 3390690-34-██████████).



Figure 5: Photograph of the undamaged circuit breaker with the undervoltage release functionality (left) and the damaged circuit breaker (right)

19. The electrical test panel in the electrical workshop is a Hose-McCann Telephone Co., Inc. test panel. Hose-McCann, located in Englewood, New Jersey, designed the electrical test panel for installation at construction of the S/R WILMINGTON in 1985 (ECN 3390690-22-██████).



Figure 6: Photograph of the S/R WILMINGTON Electrical Test Panel and Workbench.
Note: the test panel also includes a pneumatic testing area (right side).

20. At 1530, ██████████ and Christopher Erickson inspected the new circuit breaker and found it had an undervoltage release function. General Electric representatives informed investigators that replacement breakers are shipped with an under voltage release solenoid that was an accessory to be used in applications which required such protection. For applications that did not require its use, the solenoid is detached by loosening two screws. To test the under voltage release solenoid, General Electric, the breaker's manufacturer, recommended: "Do appropriate functional check as described... prior to installation." The function check reads: "1. Using rated control voltage apply power to blue under voltage coil leads. 2. Reset and turn circuit breaker on. 3. Remove control power, the circuit breaker should trip, if not, recheck accessory installation." The rated control voltage for the new circuit breaker was 480 volts (ECN 3390690-18-██████).

21. ██████████ and Christopher Erickson did not remove the under voltage release solenoid but instead decided to test the undervoltage release function on the new circuit breaker by applying a 480 volt load to the two blue wire leads that allowed the solenoid to operate (ECN 3390690-34-██████).

22. At 1535, ██████████ opened the third drawer on the storage cabinet below the workbench. The third drawer contained test leads for use with different power source receptacles on the electrical test panel. One of these test leads was used for the 480 volt receptacle (ECN 3390690-34-██████).

23. The original 480 volt test lead was not on board the vessel. The engineers were using a test lead that had been fabricated for use with the 480 volt receptacle. Engineers interviewed were unable to recall exactly when the test lead was fabricated. The fabricated test lead, or "pigtail," consisted of a four (4) prong plug, a six (6) foot insulated cord, and three bare exposed wires (ECN 3390690-31- [REDACTED]).



Figure 7: Photograph of the fabricated electrical test lead test lead or "pigtail" consisting of a four (4) prong plug, a six (6) foot insulated cord, and three bare exposed wires.

24. [REDACTED] removed the 480 volt test lead from the drawer and placed it on the wooden workbench in front of the test panel (ECN 3390690-33- [REDACTED] ECN 3390690-34- [REDACTED]).

25. [REDACTED] and Christopher Erickson discussed whether or not the test lead was the appropriate test lead for use with the 480 volt receptacle (the test panel is capable of distributing 480 volts of electricity). Of note: Christopher Erickson, as a Third Assistant Engineer on board S/R WILMINGTON, had previously, and on various occasions, used the electrical test panel and test leads, including makeshift test leads, for deck flood light maintenance, testing and repair. Based on interviews, he was familiar with using the test panel (ECN 3390690-34- [REDACTED]).

26. [REDACTED] and Christopher Erickson decided to use the test lead retrieved from the drawer to function check the undervoltage release function (ECN 3390690-33- [REDACTED] Transcript of SHEL interview with Third Engineer [REDACTED] ECN 3390690-34- [REDACTED]).

27. At 1605, [REDACTED] lifted the four (4) prong plug end. [REDACTED] inspected the connection and ensured it would fit into the 480 volt receptacle (ECN 3390690-34- [REDACTED]).



Figure 8: Photograph of the Test Panel Safety Placard and 480 Volt Receptacle

28. [REDACTED] opened the 480 volt receptacle door. Of note, the red placard (see Figure 8) on the test panel states “480 VOLTS AC DE-ENERGIZE BEFORE OPENING DOORS” (Figures 6 and 8; ECN 3390690-34-[REDACTED]).

29. [REDACTED] inserted the four (4) prong plug into the receptacle (ECN 3390690-34-[REDACTED]).

30. [REDACTED] stated he observed the switch (the switch is attached to a circuit breaker which supplies the electrical test panel with 480 volt electricity) for energizing the 480 volt receptacle to be in a tripped position. A tripped condition would cause the switch position to rest approximately halfway between the energized (ON) and de-energized (OFF) position, generally a circuit breaker trips to the open or off position. The tripped position indicates there has been an interruption in the power supply. A switch in the tripped position does not confirm an ON or OFF condition of electrical power (ECN 3390690-34-[REDACTED] Transcript of SHEL interview with First Engineer [REDACTED]).

31. [REDACTED] decided to test the test lead to determine if the receptacle was emitting power.

32. [REDACTED] Christopher Erickson, and [REDACTED] were not wearing Personal Protective Equipment (PPE) (ECN 3390690-34-[REDACTED]).

33. At 1606, [REDACTED] opened the storage cabinet below the workbench a second time to retrieve a voltmeter with insulated alligator clips to test the ON/OFF condition of the test lead. Alligator clips are spring loaded clips that have metal “jaws” resembling an alligators and are used for making temporary electrical connections (ECN 3390690-33-[REDACTED] ECN 3390690-34-[REDACTED]).

34. At 1607, Christopher Erickson picked up the 480 volt test lead. Of note, the autopsy of Christopher Erickson revealed contact burns on the palm of his left hand and the backside of his right hand (ECN 3390690-33-[REDACTED] ECN 3390690-34-[REDACTED]).

35. At 1608, Christopher Erickson asked [REDACTED] for wire nuts (ECN 3390690-33-[REDACTED] ECN 3390690-34-[REDACTED]).

36. At 1609, ██████████ looked up from rummaging through the drawer and said, "No Chris, we need alligator clips" (ECN 3390690-33-████████, ECN 3390690-34-████████).

37. ██████████ returned to looking for the voltmeter (ECN 3390690-33-████████, ECN 3390690-34-████████).

38. At 1610, Christopher Erickson came in contact with the energized bare wire working end conductors of the test lead. Note: This time is an approximation from the ship's log, filled out by a crew member after the electrocution occurred and resuscitation efforts began (ECN 3390690-12-████████).

39. ██████████ placed the switch for the 480 volt receptacle into the OFF position. ██████████ pulled the test lead from the receptacle and attempted to remove the test lead from Christopher Erickson's hands. ██████████ was not sure his attempt to remove the cord from Christopher Erickson's hands was successful (ECN 3390690-33-████████, ECN 3390690-34-████████).

40. ██████████ pulled the electrical test lead from Christopher Erickson's hands (ECN 3390690-33-████████).

41. ██████████ exited the electrical workshop and proceeded to the engine room main control. Once there, ██████████ called the Master of the vessel, ██████████ and reported the casualty (ECN 3390690-30-████████, ECN 3390690-31-████████, ECN 3390690-32-████████, ECN 3390690-33-████████, ECN 3390690-34-████████).

42. Crewmembers onboard the S/R WILMINGTON were notified, came into the workshop, and started CPR for Christopher Erickson. Of note, ██████████ and ██████████, the primary CPR providers, were unable to recall the exact times all individuals entered and exited the electrical repair workshop during the administering of CPR (ECN 3390690-30-████████, ECN 3390690-31-████████, ECN 3390690-32-████████, ECN 3390690-33-████████, ECN 3390690-34-████████).

43. At 1626, ██████████ telephoned Healthforce Medical Services in Bothell, Washington, to report Christopher Erickson had been shocked with 480 volts of electricity and needed medical assistance. Healthforce Medical Services is a third-party entity, contracted by SeaRiver Maritime Inc., to provide emergency medical assistance via telephonic instruction during medical emergencies. ██████████ requested assistance, stating the crewman was non-responsive but breathing. Dr. ██████████ of Healthforce Medical monitored the medical treatment with the ship's crew via telephone until a USCG helicopter (CG 6561) arrived at 1730. This medical attention included AED, oxygen, and an Epinephrine I.V. There was no evidence of exactly when the previous mentioned medical supplies were administered to Christopher Erickson (ECN 3390690-13-████████).

44. At 1628, Chief Mate [REDACTED] reported the marine casualty to the United States Coast Guard (USCG) Station Freeport. [REDACTED] requested assistance for an injured crew member. Two USCG logs recorded the incident as reported at 1628; however, the S/R WILMINGTON's log indicates the initial call was made at approximately 1612.

Note: This time is an approximation from the ship's log, filled out by a crew member after the electrocution occurred and resuscitation efforts began (ECN 3390690-15-[REDACTED] ECN 3390690-16-[REDACTED] ECN 3390690-09-[REDACTED] ECN 3390690-32-[REDACTED]).

45. At 1628, USCG Sector Houston/Galveston received a call from USCG Station Freeport stating that a crewmember onboard the S/R WILMINGTON had received a 480 volt shock and was unconscious (ECN 3390690-15-[REDACTED]).

46. At 1632, Sector Houston-Galveston directed USCG Air Station Houston to launch for a medical evacuation (Medevac). Sector Houston-Galveston contacted the USCG Eighth District Command Center (D8 CC) for Flight Surgeon notification and helicopter launch authorization. Unable to reach Flight Surgeon Captain Lago Velez, the D8 CC immediately contacted Flight Surgeon Commander Taylor. The D8 CC approved the helicopter Medevac launch. (ECN 3390690-14-[REDACTED]).

47. At 1638, USCG Air Station Houston logged a call from Sector Houston-Galveston directing a Medevac launch (ECN 3390690-14-[REDACTED]).

48. At 1640, the D8 CC notified Sector Houston-Galveston that the Flight Surgeon requested additional patient information (ECN 3390690-15-[REDACTED]).

49. At 1640, MSU Galveston was notified of a marine casualty onboard the S/R WILMINGTON involving the electrocution of a crewmember. MSU Galveston was notified by Sector Houston-Galveston. Sector Houston-Galveston informed MSU Galveston that contact information for the S/R WILMINGTON would be provided immediately after Sector Houston-Galveston successfully dispatched the Medevac (ECN 3390690-40-[REDACTED]).

50. At 1705, Dr. [REDACTED] of Healthforce Medical Services advised the ship's crew, "We have no further recommendations and that it is now at their (the ship's crew) discretion as to whether they continue performing CPR." Dr. [REDACTED] was advised by the ship's crew, "...that the AED screen showed a flat line without CPR...there is no pulse without compressions...the patient has no capillary refill in his toes or fingers, his skin color on his hands is beginning to turn purple and his pupils are dilated." (ECN 3390690-13-[REDACTED]).

51. At 1719, USCG Sector Houston-Galveston called MSU investigators to provide formal notification of the marine casualty with contact information for the S/R WILMINGTON's agent [REDACTED] (ECN 3390690-40-[REDACTED]).

52. At 1723, MSU investigators called [REDACTED]. [REDACTED] did not have direct information regarding the marine casualty, but provided investigators with the contact phone number of the S/R WILMINGTON (ECN 3390690-40-[REDACTED]).

53. At 1725, CG6561 arrived on-scene with the S/R WILMINGTON. The aircrew's Rescue Swimmer was deployed to the ship to evaluate the situation. The Rescue Swimmer met with the attending crewmembers that were performing CPR. Crewmembers informed the Rescue Swimmer the patient had 8 unsuccessful resuscitation attempts; received three doses of [REDACTED] and that CPR had been in progress for 50 minutes. The Rescue Swimmer directed the ship's crew to bring the patient topside for hoisting as the helicopter circled overhead (ECN 3390690-14-[REDACTED]).

54. At 1740, MSU investigators received an update from Sector Houston-Galveston that the Medevac was in progress (ECN 3390690-40-[REDACTED]).

55. At 1741, MSU investigators called the S/R WILMINGTON. MSU investigators spoke with Second Officer [REDACTED]. [REDACTED] requested to return MSU investigators phone call because the entire crew was working to get Christopher Erickson safely on board the CG6561. [REDACTED] informed MSU investigators that [REDACTED] would return the phone call as soon as possible. Coast Guard Investigations policy in the Marine Safety Manual clearly states, "...marine casualty investigations are secondary to the saving of life at sea, protection of property, and protection of the marine environment. An investigation should never supersede or impinge upon search and rescue or pollution response activities, but must be carried on concurrently..." (MSM A3-3 D.1) (ECN 3390690-40-[REDACTED]).

56. At 1749, CG6561 completed the hoist evolution and departed scene enroute to the hospital (ECN 3390690-14-[REDACTED], ECN 3390690-15-[REDACTED]).

57. At 1820, CG6561 landed at Memorial Hermann Hospital with onboard CPR still in progress. Aircraft crewmembers escorted the patient into the hospital and verbally briefed the hospital's staff on the patient's treatment history onboard the S/R WILMINGTON and onboard the Coast Guard aircraft (ECN 3390690-14-[REDACTED], ECN 3390690-15-[REDACTED]).

58. At 1830, Christopher Erickson was pronounced deceased by the attending physician (ECN 3390690-14-[REDACTED], ECN 3390690-15-[REDACTED]).

******* The following items are events and actions pertinent to the investigative effort but did not cause or contribute to the marine casualty *******

59. At 1833, [REDACTED] called MSU investigators. MSU investigators directed [REDACTED] to conduct drug and alcohol testing. [REDACTED] was also directed to separate all individuals directly involved and to secure the scene until Coast Guard investigators arrived (ECN 3390690-40-[REDACTED]).

60. At 1845, MSU investigators called SeaRiver Maritime Vice President of Operations [REDACTED] (ECN 3390690-40-[REDACTED]).

61. At 1909, MSU investigators received a phone call from [REDACTED]. [REDACTED] informed investigators the S/R WILMINGTON would be arriving at Vopak Facility on January 8, 2009, at 1000 (ECN 3390690-40-[REDACTED]).

62. On January 8, 2009, at 0748, [REDACTED] notified MSU investigators the S/R WILMINGTON would arrive at Galveston Pier 34 at 1130 (ECN 3390690-40-[REDACTED]).

63. At 1305, a USCG investigations team consisting of the MSU Senior Investigating Officer, an Investigating Petty Officer, and a USCG Marine Safety Specialist Warrant Officer (previously an Electrician's Mate) from Sector Houston-Galveston, arrived on board the S/R WILMINGTON (ECN 3390690-37-[REDACTED]).

64. Onboard the S/R WILMINGTON, the team interviewed [REDACTED]. All other members of the crew had no knowledge of the work being done in the electrical workshop (ECN 3390690-01-[REDACTED] ECN 3390690-02-[REDACTED] ECN 3390690-03-[REDACTED] ECN 3390690-04-[REDACTED]).

65. The investigators examined the scene of the incident, took photographs and spoke with management from SeaRiver Maritime (ECN 3390690-10-[REDACTED]).

66. The investigators brought vessel personnel back into the electrical workshop individually and had each of the vessel's personnel recount events and recreate their actions to the best of their recollection (ECN 3390690-10-[REDACTED]).

67. On February 12, 2009, ABS auditors conducted a scheduled audit of SeaRiver Maritime's Safety Management System and issued the associated documents. All six vessels in SeaRiver Maritime's fleet are covered by the same Safety Management System. During the audit a sampling of the items covered by the Safety Management System were reviewed. The attending auditors found no Safety Management System non-conformities. Of note, during this audit, there was no discussion of the recent electrocution fatality onboard the S/R WILMINGTON because auditors were not made aware of the casualty. (American Bureau of Shipping Audit Report, dated February 12, 2009).

68. On March 18, 2009, the investigations team met with Dr. [REDACTED] Harris County Medical Examiner's Office Forensic Coroner. Dr. [REDACTED] confirmed that there was no evidence of criminal activity. MSU investigators also examined autopsy photographs and reviewed the coroner's report (ECN 3390690-12-[REDACTED]).

69. On March 24, 2009, the MSU investigators met with S/R WILMINGTON personnel and Professional Engineer [REDACTED]. [REDACTED] was the forensic engineer retained by [REDACTED] Christopher Erickson's father. During the meeting, all parties present observed [REDACTED] examine and analyze the test lead, the new circuit breaker, and the ON/OFF switch for the 480 volt receptacle. At the conclusion of these examinations, it was noted that all items were functioning properly and no defects were found. (ECN 3390690-38-[REDACTED] ECN 3390690-39-[REDACTED]).

70. On April 3, 2009, MSU investigators subpoenaed the medical records of [REDACTED] due to repeated difficulties in scheduling an interview with [REDACTED] for medical reasons. The medical records revealed that subsequent to the marine casualty, [REDACTED] had been diagnosed with Post Traumatic Stress Disorder. His physician also further recommended that [REDACTED] not be interviewed again for at least six (6) months (Subpoena date April 3, 2009).

71. On April 3, 2009, MSU Galveston investigators, accompanied by investigators from Coast Guard Sector Hampton Roads, attended the S/R WILMINGTON in Norfolk, Virginia. The investigators conducted an inspection of the electrical test panel with the crew of the S/R WILMINGTON.
72. On April 4, 2009, MSU Galveston investigators, accompanied by investigators from Coast Guard Sector Hampton Roads, again attended the S/R WILMINGTON in Norfolk, Virginia. The investigations team met with [REDACTED] F.M. Brooks (Professional Engineer retained by SeaRiver Maritime), the crew of the S/R WILMINGTON, David Erickson, and shore-side personnel from SeaRiver Maritime. During the meeting, Roger Owens conducted electrical tests in accordance with the written protocol agreed upon by all parties. Mr. [REDACTED] found that all equipment was properly installed and functioning as prescribed. F. M. Brooks also found that all equipment was installed correctly and functioning properly (ECN 3390690-38 [REDACTED], ECN 3390690-39- [REDACTED]).
73. On April 16, 2009, the Coast Guard issued MARINE SAFETY ALERT 01-09 recommending the maritime industry follow electrical safety precautions such as electrical systems training, PPE, and appropriate supervision (U.S. Coast Guard MARINE SAFETY ALERT 01-09).
74. On May 15, 2009, MSU investigators met with OSHA Compliance Assistance Specialist [REDACTED] to discuss differences between OSHA regulations and Coast Guard regulations. [REDACTED] explained that OSHA regulations, though not required on U.S. inspected vessels, require strict training on electrical safe work practices and qualification guidelines as well as requirements for PPE when handling electrical components (E-mail chain between the Coast Guard and [REDACTED] of OSHA).
75. On May 27, 2009, the Commanding Officer of MSU Galveston submitted a letter to SeaRiver Maritime Inc. The letter informed SeaRiver Maritime that the Officer in Charge Marine Inspection (OCMI) had determined that a Safety Management System "major non-conformity" existed prior to the electrocution death of a licensed Third Assistant Engineer onboard the S/R WILMINGTON on January 7, 2009 (see Enclosure 9).
76. On June 3, 2009, the USCG investigations team again met with OSHA to discuss electrical safety regulations (E-mail chain between the Coast Guard and Mark Hernandez of OSHA).
77. On June 17, 2009, the investigations team conducted a second round of interviews with [REDACTED] and [REDACTED] (ECN 3390690-30 [REDACTED], ECN 3390690-31- [REDACTED]).
78. On June 24, 2009, [REDACTED] and SeaRiver Maritime General Counsel representative, [REDACTED] met with the Commanding Officer of MSU Galveston and the investigations team to discuss the determination of a Safety Management System major non-conformity and proposed corrective actions (MSU Galveston visitor log).

79. On June 24, 2009, Phelps Dunbar, LLP, on behalf of SeaRiver Maritime, requested the OCMCI reconsider the determination that a Safety Management System “major non-conformity” existed prior to the electrocution death of a licensed Third Assistant Engineer onboard the S/R WILMINGTON (Phelps Dunbar letter, dated June 24, 2009).

80. On June 25, 2009, SeaRiver Maritime submitted a letter documenting their active and planned corrective actions to prevent a similar casualty from occurring onboard the S/R WILMINGTON (SeaRiver Maritime letter, dated June 25, 2009).

81. On July 7, 2009, MSU investigators conducted a second interview with [REDACTED] (ECN 3390690-32-[REDACTED])

82. On July 8, 2009, MSU investigators conducted a second interview with [REDACTED] (ECN 3390690-33-[REDACTED])

83. On July 9, 2009, MSU investigators attended the S/R WILMINGTON in Beaumont, Texas. Investigators met with crewmembers and shore-side safety management personnel. Investigators also re-examined the electrical workshop, electrical test panel, and electrical equipment associated with the test panel. MSU investigators found makeshift electrical test leads onboard the S/R WILMINGTON (E-mails between the Coast Guard and SeaRiver Maritime).

84. On July 14, 2009, the Commanding Officer of MSU Galveston submitted a letter to SeaRiver Maritime reaffirming the OCMCI’s determination that a Safety Management System major non-conformity existed prior to the electrocution death of a licensed Third Assistant Engineer onboard the S/R WILMINGTON on January 7, 2009 (Letter from OCMCI to SeaRiver Maritime, dated July 14, 2009). Note, the OCMCI’s determination of a Safety Management major non-conformity is explained further in the causal analysis and conclusions sections of this report.

85. On July 28, 2009, Blank Rome, LLP, on behalf of SeaRiver Maritime, requested an extension of time to appeal the OCMCI’s determination of a major non-conformity.

86. On July 30, 2009, the Eighth Coast Guard District granted a 14-day extension to Blank Rome, LLP for the regulatory appeals timeline.

87. On August 12, 2009, after approval from [REDACTED] medical care provider, MSU investigators traveled to New York, New York, and conducted a second interview with the First Engineer (ECN 3390690-34-[REDACTED])

88. On August 19, 2009, representatives from the U.S. Coast Guard, American Bureau of Shipping, Blank Rome, and SeaRiver Maritime met to discuss the electrocution death of Christopher Erickson in order to develop recommendations to improve processes and systems in an effort to prevent the future loss of life.

89. On August 24, 2009, Blank Rome, LLP, on behalf of SeaRiver Maritime, requested an additional 14-day extension to appeal the OCMCI’s determination of a major non-conformity.

90. On August 25, 2009, the Eighth Coast Guard District granted an additional 14-day extension to Blank Rome, LLP for the regulatory appeals timeline.

91. On September 10, 2009, Blank Rome, LLP, on behalf of SeaRiver Maritime, appealed the OCMI's determination of a Safety Management System major non-conformity onboard the SR WILMINGTON.

92. On September 26, 2009, ABS and the Coast Guard Liaison to Authorized and Recognized Classification Societies conducted an audit of SeaRiver Maritime's corrective actions onboard S/R WILMINGTON in Fort Lauderdale, Florida. At the conclusion of the audit, the ABS Auditor, Mr. [REDACTED] advised Commander Caron that "the CG was on target by using ISM application as a tool, he noted that several non-conformities did exist with regard to their SMS prior to the accident of January 7, 2009 based on reviews of past logs, SMS and crew interviews." The audit found no outstanding non-conformities and approved all corrective actions created and described by Sea River Maritime in a corrective actions letter dated June 25, 2009 (E-mail from CDR Caron to CDR Elliott, dated September 28, 2009, and ABS Audit Report, dated October 6, 2009).

93. On December 17, 2009 the U.S. Coast Guard's Eighth District Commander determined SeaRiver Maritime's arguments in its appeal of the OCMI's determination of a Safety Management System major non-conformity were not supported and that a Safety Management System major non-conformity existed prior to the electrocution of Christopher Erickson onboard the S/R WILMINGTON on January 7, 2009 (see Enclosure 14).

III. CAUSAL ANALYSIS

Maritime transportation is a complex production system comprised of five (5) main elements. The elements, **Organization**, **Workplace Factors**, **Preconditions**, **Production Factors**, and **Defense Factors**, when working in synchronized harmony create a safe product or operation (MSM Volume V; B4-2). When these elements are not synchronized, a "latent unsafe condition" (LUC) arises. Latent unsafe conditions are hazardous conditions within an element of the system that may lay dormant, only becoming evident when they combine with an unsafe act or decision. The combination creates an active failure resulting in a negative outcome or event. Latent unsafe conditions in the maritime transportation system exist for a period of time and can be seen as a hole or gap in the element (MSM Volume V; B4-1 B.3.c). When the holes align throughout all of the elements, the potential and possibility of a threat or hazard passing through all elements is greater. These threats may lead to accidents and marine casualties. This casualty investigation sheds light on the elements and the possible "holes" in these elements that allowed a threat (electricity) to cause the marine casualty (electrocution).

The following sections present the analysis of the Organization, Workplace Factors, Preconditions, Production Factors, and Defense Factors. This discussion of the marine transportation system elements highlights the latent unsafe conditions present in each element and how these latent unsafe conditions contributed to this marine casualty. The U.S. Coast Guard Marine Information for Safety and Law Enforcement (MISLE) and the Marine Safety Manual provide investigators with terms to categorize the latent unsafe conditions found during an investigation. Within the discussion of each element, the

underlined terms are the applicable terms investigators are required to use, in accordance with MISLE and MSM requirements, to conduct the causal analysis.

In accordance with the International Maritime Organization and the U.S. Coast Guard Marine Safety Manual, causal analysis is the process for investigating human factors that caused a marine casualty to take place. Investigators reviewed work-rest histories, drug and alcohol physiological effects, and industry practices to discover contributing factors to this marine casualty.

Interviews of the S/R WILMINGTON crewmembers revealed no evidence of undue stress or fatigue at the time of the casualty. The crew was preparing to conduct a transit to Bayport, Texas. This was an evolution the crew was very familiar with based on interviews of the crew. Additionally, the crew had no major projects to complete at the time of the casualty. Questions to the crew regarding distractions or fatigue revealed that crewmembers did not feel they were distracted or tired. The work rest histories revealed that at the time of the casualty no crewmember on board the S/R WILMINGTON had worked over twelve (12) hours in the twenty four (24) hours prior to the casualty. The review of the work rest histories allowed investigators to rule out fatigue as a contributing factor to this casualty. Investigators also examined whether the use of intoxicants (drugs or alcohol) was a factor in this casualty. All tests were conducted in accordance with the requirements of 46 Code of Federal Regulations Part 4.06-3. Crewmembers were tested for alcohol less than two (2) hours after the casualty. The crewmembers' test results revealed [REDACTED] blood alcohol content. Crewmembers were also tested for drug use less than twenty four (24) hours after the casualty. The results of the drug tests for the crew were all [REDACTED]. The results allowed investigators to determine neither drug nor alcohol use played a role in this casualty.

To determine how a marine casualty occurred, investigators must first identify the "Initiating Event" for the casualty. For the purposes of analyzing the causes of a casualty, the initiating event is simply the first unwanted or negative outcome in the findings of fact (timeline). The initiating event does not have to be the marine casualty and, in this case, it is not. The initiating event for this casualty is Finding of Fact Number 28. A placard above the switch for the 480 volt receptacle states "De-energize before opening door." [REDACTED] opened the 480 volt receptacle door without confirming the receptacle was de-energized. This action was contrary to the safety placard. This was also an unwanted event because it created the potential situation where there could be an "unexpected release of hazardous energy" (electricity-the phrase "unexpected release of hazardous energy is taken directly from the S/R WILMINGTON's safety management system).

No evidence suggesting that either [REDACTED] or Christopher Erickson ensured the receptacle was de-energized prior to opening the receptacle door was found. The next unwanted event or "subsequent event" occurred when Christopher Erickson picked up the makeshift electrical test lead. Based on interviews with [REDACTED] and [REDACTED], investigators ascertained that Christopher Erickson picked up the electrical test lead in an attempt to connect the bare wires of the test lead to the undervoltage release solenoid on the new circuit breaker.

Organization

The organization element, which includes “decision makers,” is the first line of protection for the “system.” Decisions made at the organizational level may create latent unsafe conditions. The U.S. Coast Guard Marine Safety Manual, Volume V (MSM Volume V; B.2.b), discusses organizations and decision makers:

In order for the system to operate, it must have an initial direction. At the organizational level, decision makers respond to the pressures, demands, and opportunities in the outside world and set the goals for the system. They also direct, at a strategic level, the ways in which the system will reach these goals... The organization element is where the goals are set and a means to reach them is provided... Decision makers are the high level architects and managers of the system. They set the rules and objectives for the system.

The decision makers or architects of the system in which the S/R WILMINGTON is operated and inspected, and in which this marine casualty occurred, include SeaRiver Maritime, Inc., the American Bureau of Shipping (ABS), and the United States Coast Guard.

SeaRiver Maritime, Inc.: SeaRiver Maritime was the primary decision maker regarding the safety of the S/R WILMINGTON’s crew and the Safety Management System in place at the time of the marine casualty.

During the investigation, objective evidence, which is defined as “quantitative or qualitative information, records or statements of fact pertaining to safety or to the existence and implementation of a safety management system element, which is based on observation, measurement or test and which can be verified,” revealed the existence of a major non-conformity in SeaRiver Maritime’s Safety Management System due to the lack of effective and systematic implementation of requirements of the International Safety Management (ISM) Code.

A major non-conformity is defined as an identifiable deviation which poses a serious threat to personnel or vessel safety or a serious risk to the environment and requires immediate corrective action; in addition, the lack of effective and systematic implementation of a requirement of the International Safety Management (ISM) Code is also considered a major non-conformity.”¹

The investigative team reviewed more than 350 work permits from the S/R WILMINGTON. These work permits covered the period from February 2007 until January 2009. This review was essential to the determination of a major non-conformity within the Safety Management System. The determination of a major non-conformity was

¹ Code of Federal Regulations (33 CFR 96.120). The ISM Code defines “major non-conformity” as “an identifiable deviation that poses a serious threat to the safety of personnel or the ship or a serious risk to the environment that requires immediate corrective action and includes the lack of effective and systematic implementation of a requirement of this Code.”

also based on a thorough review of statements of fact pertaining to safety and numerous historical records collected during the investigation.²

Prior to issuing the determination of a major non-conformity on May 27, 2009, the OCMI's decision was reviewed and approved by Sector Houston-Galveston, the Office of Vessel Activities (CG-543), the Office of Quality Assurance and Traveling Inspectors (CG-546), and the Coast Guard's Liaison to Authorized and Recognized Classification Societies.

Statements by SeaRiver Maritime employees as well as the previously mentioned work permit review confirmed that work permits were not completed for hazardous work conducted in the electrical workshop. While SeaRiver Maritime's Safety Management System required a "work permit" for "seven (7) job categories," including "electrical work," work permits were routinely not completed prior to conducting work within the S/R WILMINGTON's electrical workshop. This pattern of failing to prepare work permits represents a systematic failure to effectively implement safeguards required in SeaRiver Maritime's Safety Management System and a failure to meet fundamental objectives of the ISM Code.

While the Safety Management System states "the standard permit process may be bypassed during emergency response when the Master has determined that such action is necessary for the safety of the vessel, crew and/or environment," based on the investigation team's findings, the replacement of the breaker did not constitute an "emergency response" on January 7, 2009. For this reason, a standard work permit should have been processed. The work party's failure to complete the required standard work permit, which would have included conducting a Job Hazard Analysis, Lock-Out/Tag-Out procedures, personnel protective equipment, and a safety observer, constituted an "identifiable deviation" from S/R WILMINGTON's Safety Management System and clearly posed a serious threat to personnel involved.

Additionally, the corded three-conductor electrical test lead used to connect to the breaker, also called a "pigtail," was determined to be "makeshift (fabricated by the crew, not the original)" equipment. Specifically, the portable leads historically used in the electrical workshop onboard the S/R WILMINGTON, and at the time of Mr. Erickson's electrocution death, were not in accordance with the approved Drawing 689-12, Alt. 1 (Detail "G"), dated June 14th, 1982.³ Additionally, a Chief Engineer onboard the S/R WILMINGTON specifically told the OCMI's designated representative that the subject electrical pigtails were considered "makeshift" equipment during an onboard interview on July 9, 2009.

The electrical test lead should have been designed with high voltage insulated alligator clips instead of the bare wires that were found on the electrical supply line involved in this marine casualty. The excessive length of the electrical supply line also allowed

² Coast Guard Investigating Officers reviewed over 350 S/R WILMINGTON Work Permits, dated February 2007 to January 2009.

³ Hose-McCann Telephone Co., Inc., Electrical Test Panel Wiring Diagram, Drawing 689-12 Alt. 1, Detail G, Portable Leads, dated June 14, 1982.

crewmembers to utilize an energized electrical supply line even if not standing on the required non-conductive matting.

Enclosures 9 through 14, particularly the OCMI's determination letters of May 27, 2009 and July 14, 2009, provide a comprehensive analysis of the existing Safety Management System major non-conformity that represented an identifiable deviation from the ISM Code and posed a serious threat to personnel onboard the S/R WILMINGTON.

American Bureau of Shipping: The American Bureau of Shipping, in accordance with the Alternate Compliance Program, is responsible for ensuring S/R WILMINGTON's Safety Management System remains in compliance with the International Safety Management Code.

The Alternate Compliance Program (ACP) is a voluntary alternative process for a U.S. registered vessel to obtain a Coast Guard Certificate of Inspection (COI) by complying with the standards of an authorized classification society, International Conventions and a U.S. Supplement. The ACP is an alternative to complying with vessel certification and inspection standards contained in Title 46, Code of Federal Regulations (CFR) and administered through inspections conducted by U.S. Coast Guard personnel. According to U.S. Coast Guard guidance, the classification society authorization is intended to reduce the regulatory burden on maritime industry while maintaining existing levels of safety and provide the maritime industry with flexibility in determining how to build and operate U.S. flagged vessels.

As an ACP authorized classification society (ACS), the American Bureau of Shipping acts for the Coast Guard in carrying out all required inspections to the extent that the Coast Guard may issue a Certificate of Inspection. The classification society assumes the primary responsibility for tracking a vessel's condition, initiating timely action to correct known deficiencies and making notification to the Coast Guard when owners do not comply with the recommendations of the classification society.

██████████ in his study *The Liability of Classification Societies* for the International Max Planck Research School for Maritime Affairs at the University of Hamburg,⁴ presents several challenges for classification societies that are applicable to this investigation's analysis:

The Dual Role of Classification Societies: The issue of classification societies serving two masters, both the Flag State and the vessel owner, has been discussed in previous U.S. Coast Guard marine casualty investigations. ██████████ notes:

Classification societies usually work at the same time for the flag State and for the shipowner...the classification society is paid by the shipowner for these surveys.... This dual role of classification societies carrying out public functions on the basis of a private contract may cause a conflict of interest, especially when the shipowner has a large fleet and/or the classification society is economically dependent upon the shipowner....In

⁴ Lagoni, Nicolai, *The Liability of Classification Societies*, International Max Planck Research School for Maritime Affairs at the University of Hamburg, Hamburg Studies on Maritime Affairs Volume 9, Springer Berlin Heidelberg, New York, 2007.

light of this conflict of interest, the lack of control over classification societies which carry out the entire flag State control has been criticized.⁵

Over 25-years ago in the conclusions of the *SS Marine Electric Marine Casualty Report*, dated July 25, 1984, the U.S. Coast Guard Marine Board noted:

... ABS surveys and visits are oriented toward protecting the best interest of marine insurance underwriters, and not for the enforcement of Federal safety statutes and regulations. Since the cost of these surveys and visits is borne by the owners, or other interested parties, the attending surveyor is subject to the influence of such persons.⁶

The Commandant of the U.S. Coast Guard disagreed with this conclusion, stating;

This conclusion is not supported by the findings of fact and is not concurred with. ABS or any other classification society surveys, when performed for the Coast Guard, are performed on behalf of the Administration's interest... The MARINE ELECTRIC surveys in question were poorly conducted, but that fact does not condemn the entire system of third party delegation which has been authorized and encouraged by Congress.⁷

In regards to the S/R WILMINGTON, a U.S. flagged vessel participating in the Alternate Compliance Program, the American Bureau of Shipping was responsible for ensuring the vessel's Safety Management System was in compliance with the International Safety Management Code and U.S. regulations. While the American Bureau of Shipping met the basic regulatory intent to audit the vessel's Safety Management System, the investigation revealed that these audits were not line-by-line inspections of the Safety Management System, but rather a random sampling of the components of SeaRiver Maritime's Safety Management System. The limited scope of these audits failed to detect the historical non-conformities within the system. Due to the nature of the random sampling, ABS auditors also failed to discover that an electrocution death had occurred onboard the S/R WILMINGTON during the first audit conducted after the marine casualty of January 7, 2009.

Of note, in response to the U.S. Coast Guard's determination of a major non-conformity, the American Bureau of Shipping did not take action. The organization did not offer an opinion nor did they appear to have any obligation to conduct a follow-up audit to confirm the legitimacy of the Safety Management System or the safety of the mariners onboard the S/R WILMINGTON unless specifically directed to do so by the U.S. Coast Guard.⁸

⁵ Lagoni, pp 26-27.

⁶ U.S. Coast Guard Marine Board of Investigation Report and Commandant's Actions, Marine Casualty Report, SS Marine Electric, O.N. 245675, Capsizing and Sinking in the Atlantic Ocean on 12 February 1983 with Multiple Loss of Life, Report No. 16732/0001 HQS 83, dated July 25, 1984, p 117.

⁷ U.S. Coast Guard Marine Board of Investigation Report and Commandant's Actions, Marine Casualty Report, SS Marine Electric, p 4.

⁸ Navigation and Vessel Inspection Circular No. 02-95, Change 2, Section 7, Paragraph j, states: "The Coast Guard may request that a classification society surveyor attend the vessel to verify compliance with any certificate issued by the ACS (Authorized Classification Society)... The Coast Guard will initiate the request for attendance of a classification society surveyor with the vessel's master and/or the vessel's company representative whenever possible so that they may assume responsibility for requesting the attendance of the

Rather, Coast Guard investigating officers were directed to speak with ABS auditors only with a representative of their legal firm, Bierne, Maynard and Parsons, present.

Following several discussions with American Bureau of Shipping representatives and a formal meeting with American Bureau of Shipping auditors and their legal representatives, Bierne, Maynard and Parsons, on August 19, 2009, a follow-up ABS verification audit was agreed upon. On September 26, 2009, Mr. [REDACTED] an ABS Auditor, and Commander Nick Caron, Coast Guard Liaison to Authorized and Recognized Classification Societies, conducted a verification audit onboard the S/R WILMINGTON in Fort Lauderdale, Florida. Commander Caron stated that Mr. [REDACTED] "advised him that the CG was on target by using ISM application as a tool, he noted that several non-conformities did exist with regard to their SMS prior to the accident of 7 Jan 09 based on reviews of past logs, SMS and crew interviews."

Selling Safety in a Competitive Environment:

The second conflict of interest addresses the contradiction of selling safety to someone else and competing for clients at the same time. The market for classification of vessels has become highly competitive and volatile. Currently, most of the societies try to raise their market share.⁹

In The Reminiscences of Admiral James S. Gracey, U.S. Coast Guard (Retired); Interviewed by Paul Stillwell, the Commandant of the Coast Guard (1982 to 1986) at the time of the SS Marine Electric investigation discusses the Coast Guard's relationship with the American Bureau of Shipping:

We worked very closely with the American Bureau of Shipping in developing ways to share inspection work, accepting theirs for ours, etc. We didn't go as fast as they wanted us to go into having them take over a lot more of our Coast Guard functions. There was some concern that because they were doing a lot of their work for insurance purposes, and there was some feeling amongst some of our Merchant Marine Safety people that there was a potential conflict of interest. So we kind of slowed down a bit and said, "Let's level off where we are in the amount of delegation that we've done and the amount of split. Let's stay with that for a while and later take a second look." That bothered some of the more senior people at ABS, and some of the ship owners and shipping company owners. They thought that we had some other motive in mind, that we were trying to hog it all into the government, especially since I was arguing against privatizing. And I kept pointing out my theme that it was all "A Question of Balance." There was a need for government to have a role in prescribing and maintaining safety in marine transportation. We had to find the right balance for the times. But there were a couple of them that never did get happy with that.¹⁰

An underlying premise of the Alternate Compliance Program is that "international and third party standards provide a level of vessel safety and environmental protection

classification society surveyor or auditor. However, if the master or company declines to make the request, the Coast Guard may directly request classification society attendance..."

⁹ Lagoni, p 29.

¹⁰ The Reminiscences of Admiral James S. Gracey, U.S. Coast Guard (Retired); Interviewed by Paul Stillwell, U.S. Naval Institute, Annapolis, Maryland, 2004.

equivalent to current Coast Guard regulations."¹¹ The Navigational and Vessel Inspection Circular (NVIC), 02-95, Change 2, also states: "The Coast Guard and the ABS executed a Memorandum of Understanding (MOU) that, among other things, delegated authority to the ABS to inspect eligible vessels using an approved ACP supplement."¹²

In June 2009, the Paris Memorandum of Understanding on Port State Control Annual Report noted that the United States fell from the "white list" to the "grey list" in the company of Iran.

Flags with an average performance are shown on the "Grey List". Their appearance on this list may act as an incentive to improve and move to the "White List"...Iran and the United States moved down from "White" to "Grey."¹³

Commandant (CG-543) reported that *"Of the seven detentions (over a three year period) two were for the same uninspected tug on the same voyage in two different ports. The remainder of the detentions were for inspected vessels, all under ACP."* Thus, the majority of these U.S. vessels detained internationally for substandard examination results were participating in the Alternate Compliance Program, like the S/R WILMINGTON.

Shipowners/Operators Have to Report Damage:

The third conflict of interest is one which is practically impossible to solve: the shipowner or operator has to report any possible deficiencies of the vessel which require repair and call upon the classification society to have them surveyed. As classification societies depend on this cooperation, they are not a fully independent survey organization. They cannot survey the vessel on their own initiative, but are dependent on their contracting party... It is far from ideal that those who must be controlled need to allow the control, and even have to report that they require to be controlled.¹⁴

During the investigation, Mr. [REDACTED] the ABS lead auditor, and Mr. [REDACTED] the observing auditor that conducted a post-casualty audit on February 12, 2009, stated that SeaRiver Maritime did not inform them or ABS of any non-conformities onboard the S/R WILMINGTON at the time of their annual audit. Additionally, the ABS auditors stated they had no knowledge of an injury or death onboard the S/R WILMINGTON until they were notified by the U.S. Coast Guard. According to the ABS Attorney, Mr. [REDACTED] of Bierne, Maynard and Parsons, SeaRiver Maritime did not inform the American

¹¹ U.S. Coast Guard Navigation and Vessel Inspection Circular No. 02-95, Change 2, COMDTPUB P16700.4, dated May 5, 1996.

¹² NVIC 02-95, Change 2, was signed by Admiral Thomas Gilmour in May 2006. In June 2006, the American Bureau of Shipping announced that Admiral Gilmour was selected as President of ABS Americas. Maritime News, June 2006, [<http://coltoncompany.com/newsandcomment/news/2006/06.htm>]

¹³ The Paris Memorandum of Understanding on Port State Control, "Port State Control: Making Headway," Annual Report, Paris MOU on Port State Control, Annual Report 2008, June 2009. The Paris MOU is an administrative agreement between the maritime authorities of twenty-seven European countries and Canada. It entered into operation on 1 July 1982. Since that date, the Paris Memorandum has been amended several times to accommodate new safety and marine environment requirements stemming from the International Maritime Organization (IMO) as well as other developments such as the EU Directives which address marine safety.

¹⁴ Lagoni, p 34.

Bureau of Shipping of the electrocution death of Christopher Erickson during the audit conducted on February 12, 2009.

However, SeaRiver Maritime, in a letter dated June 24, 2009, cited this post-casualty audit as proof that ABS did not identify any ‘non-conformity’ or ‘major non-conformity’ and argued that SeaRiver Maritime's Safety Management System met all of the ISM Code functional standards and performance elements. Since ABS depended upon SeaRiver Maritime to report non-conformities in their Safety Management System, the classification society cannot be considered a fully independent survey organization.

During a meeting on August 19th, 2009, attorneys representing SeaRiver argued that, despite senior SeaRiver employees previously stating that a “non-conformity” existed onboard the S/R WILMINGTON, SeaRiver’s definition of “non-conformity” and “major non-conformity” do not align with the regulatory and ISM Code definitions of these terms. Altering the regulatory definitions, SeaRiver representatives stated that they did not feel obligated to report the electrocution death of a licensed mariner onboard a U.S. certificated ACP vessel during the post-casualty American Bureau of Shipping Safety Management System Audit on February 12, 2009.

The SeaRiver Maritime and American Bureau of Shipping legal teams stated on August 19, 2009, that the Coast Guard had not provided sufficient guidance on audit expectations or what constitutes a Safety Management System non-conformity and major non-conformity. These perceptions by SeaRiver Maritime and the American Bureau of Shipping led to the investigation team’s recommendation to revise guidance to Authorized Organizations and the maritime industry regarding the implementation and auditing of Safety Management Systems onboard U.S. inspected vessels.

United States Coast Guard: The U.S. Coast Guard is responsible for providing oversight of the American Bureau of Shipping in accordance with the Alternate Compliance Program guidelines onboard the S/R WILMINGTON and enforcing applicable Code of Federal Regulations onboard the vessel.

The Alternate Compliance Program: The Alternate Compliance Program allows classification societies to assume the primary responsibility for tracking a vessel’s condition, initiating timely action to correct known deficiencies and making notification to the Coast Guard when owners do not comply with the recommendations of the classification society. Navigation and Vessel Inspection Circular (NVIC) 02-95 Change 2, dated May 5, 2006, entitled “The Alternate Compliance Program (ACP),” notes owners should not construe this as meaning that the Coast Guard is not involved in critical decision-making or that the Coast Guard is somehow prevented from attending their vessel in order to verify compliance.

The U.S. Coast Guard is the Standards Organization that had oversight responsibility over the American Bureau of Shipping. The intent of 33 Code of Federal Regulations Part 96, entitled Rules for the Safe Operation of Vessels and Safety Management Systems, and NVIC 02-95, is for the U.S. Coast Guard to oversee all Authorized Classification Society activities to ensure audits are completed to the standards of the International Safety Management Code.

At the conclusion of this investigation, investigators found that the Coast Guard had limited oversight over the American Bureau of Shipping. Specifically, there was no evidence that Coast Guard personnel oversaw ISM audits onboard the S/R WILMINGTON in the six years prior to the marine casualty. Thus, inadequate oversight by the U.S. Coast Guard created a latent unsafe condition.

A quote attributed to Admiral William Benkert, Chief, Office of Merchant Marine Safety from 1974 to 1978, addresses this issue:

It is also considered mandatory, regardless of any delegations of authority that may be contemplated, that the Coast Guard retain its professional in-house capability to insure continuity and positive proper technical and administrative oversight of any and all organizations performing functions on behalf of the Coast Guard. Should this not be done, non-standard efforts could result. The direct participation of "foreign" organizations in this program might well present the Coast Guard with a well-nigh impossible task.¹⁵

In Commandant (CG-543) Policy Letter 09-04, regarding the Coast Guard's Marine Inspector and Port State Control Officer Certification Policy, the guidance states, "Note: Completion of Streamlined Inspection Program, Alternate Compliance Program, or Maritime Security Program audits and oversight inspections conducted *in lieu of traditional regulatory inspections* [emphasis added] satisfy certification requirements for applicable Marine Inspector competencies. Thus, the U.S. Coast Guard accepts random audits of U.S. flagged vessels conducted by third parties in lieu of regulatory inspections and, with this policy, now accepts that inspectors will be certified to endorse Certificates of Inspection at this reduced level of oversight in lieu of a regulatory inspection.

Coast Guard Regulations: The Code of Federal Regulations is absent regulations requiring a commercial vessel's Safety Management System to have specific electrical test procedures or require personal protective equipment. Additionally, while 46 CFR 110, which is applicable to the electrical installations on board the S/R WILMINGTON, gives guidance and direction on how to install electrical machinery, these regulations do not provide specific electrical safety regulations mandating the use of personal protective equipment. Based on inspections by Coast Guard electrical experts and two professional engineers, the installation of the electrical test panel was appropriate. Because the installation was correct, there is no evidence that suggests the equipment caused this marine casualty. Thus, the absent regulations related to personal electrical safety created a gap between the operator and the equipment.

This lack of specific electrical safe work practices created a latent unsafe condition. While Occupational Safety and Health Administration (OSHA) regulations specifically address electrical safe work practices, U.S. Coast Guard regulations do not specifically address these safety issues onboard commercial vessels. In essence, land-based regulations are more specific than marine safety regulations, creating a disparity of how the federal government regulates personal safety while also creating situations where workers are relatively less safe onboard a vessel when emergency medical treatment is typically less accessible. The disparity between OSHA and Coast Guard regulations is not limited to

¹⁵ U.S. Coast Guard, Coast Guard Portal "Marine Inspection Culture," August 31, 2009.

electrical safety. For example, for commercial divers, OSHA requires a decompression chamber onsite for commercial diving operations in waters greater than 100-fsw (29 CFR 1910.425 (b)), while the Coast Guard requires a decompression chamber onsite for commercial diving operations in waters greater than 130-fsw (46 CFR 197.432 (e) (2)). Again, this regulatory disparity permits workers under Coast Guard's regulatory oversight to comply with less stringent safety standards while they are at the same time working in locations typically less accessible to professional emergency medical care.

Workplace Factors

Workplace Factors are the second line of defense. The Workplace Factors element is comprised of the actions and decisions of managers and supervisors running the job, and how those actions and decisions impact line workers. For example, a latent unsafe condition resulting from a poor decision by the owner/operator of a ship can be mitigated or eliminated by the good decision of the master of the same ship. Latent unsafe conditions can exist within this system when the decisions of the managers and supervisors directly running a job are not made in the best interest of the operator or safe production. For this marine casualty, the manager was [REDACTED]. The line workers were Christopher Erickson and [REDACTED]. The job was checking the undervoltage release functionality of the breaker using the electrical test panel.

A latent unsafe condition existed in "supervision" because work with an unnecessary hazard was authorized onboard the S/R WILMINGTON. Electricity was identified as a hazard onboard the S/R WILMINGTON in the Safety Management System. Evidence was provided to show that in various locations throughout the ship, other than the electrical workshop, individuals being exposed to the hazard were required to wear appropriate Personal Protective Equipment and complete thorough work permits and comprehensive Lockout/Tagout procedures. For example, the procedural requirements for the removal of the damaged circuit breaker necessitated a work permit and a lockout device. Personal Protective Equipment was worn while the breaker was removed. Evidence and testimony revealed engineers had previously utilized a makeshift test lead and did not wear personal protective equipment when working with the electrical test panel. The utilization of the makeshift electrical test lead for a prolonged period of time is a violation of S/R WILMINGTON's Safety Management System. However, testimony from various crew members indicated that using the makeshift test lead was not seen as a problem. All relevant evidence indicates that in the electrical workshop, the requirements for working with the hazard (electricity) were not the same as the requirements for working with electricity in other areas of the vessel.

A latent unsafe condition in "the operation" existed while working in the electrical workshop minutes prior to the casualty. Incorrect data was provided to Christopher Erickson and [REDACTED] by [REDACTED]. During interviews of [REDACTED] statements were made that he did not know whether or not the 480 volt receptacle was energized. [REDACTED] never communicated or briefed this to Christopher Erickson and [REDACTED]. Additionally, he made the decision to test the electrical test lead in order to learn whether or not the receptacle was energized. This decision and lack of communication, though indirect, provided incorrect data to Christopher Erickson and [REDACTED]. Correct data would have been [REDACTED] informing all personnel in the space he did not know if the receptacle and test lead were energized. The correct data

regarding whether or not the receptacle and test were energized may have prevented Christopher Erickson from grabbing the test lead.

Preconditions

The Preconditions Element involves the physical condition of equipment prior to a marine casualty. Preconditions also involve the mental and physical condition of the crew and their relationships with one another.

Latent unsafe conditions in the form of a “People - Person Mismatch” existed onboard the S/R WILMINGTON. Based on interviews, investigators determined that [REDACTED] and Christopher Erickson never discussed the entire scope of the circuit breaker repair and replacement job. Evidence from the same interviews confirmed that Christopher Erickson was under the impression the engineers were going to connect the bare wires of the working end conductors of the test lead to the blue wires of the undervoltage release solenoid on the new breaker using wire nuts. [REDACTED] intended to use testing equipment [volt meter] on the bare wires of the working end conductors to see if the 480 volt receptacle was working properly. The task at hand and associated hazards were not discussed as is demonstrated by the variance of the perceived job by the individuals involved.

Latent unsafe conditions in “equipment” existed. Investigators discovered the electrical test lead being used at the time of the casualty was not the original test lead provided by the test panel manufacturer for use with the electrical test panel. The electrical test lead being used was created by the crew at some point since the commissioning of the S/R WILMINGTON. The test lead originally provided was designed with insulated alligator clips connected to the bare wires of the working end conductors. These alligator clips were an engineered defense in place to decrease the possibility of personnel touching bare wires. The test lead being used did not have these insulated alligator clips. The U.S. Coast Guard’s Marine Safety Manual guidance specifically recognizes that equipment not properly maintained can create the potential for casualties.

Production Factors

Production Factors are the failures or violations that occur during an operation. Production Factors combined with latent unsafe conditions from the Organization, Workplace Factors, and Preconditions elements lead to the initiating event.

Investigators are guided by the Marine Safety Manual to use the Generic Error Modeling System (GEMS) as the framework for human error analysis. GEMS explores how people solve problems and do things using skill-based, rule-based and knowledge-based performance (MSM Volume V; B4-13 C.3).

Using the Generic Error Modeling System, the unsafe acts and decisions associated with the casualty may be categorized and subcategorized to fully analyze and defined human error. The underlined terms in the Production Factors section are the terms used to describe the categories, sub-categories and final definition of human error.

For this marine casualty, the error or unsafe act was [REDACTED] not following the instruction on the red placard above the switch on the electrical test panel. The placard instructed users to ensure the 480 volt receptacle was de-energized before opening the receptacle door. This unsafe act is categorized as a planning error. A planning error is “a mistake or violation that results when the person executes a decision or action as they intended, but that action was inappropriate for the situation” (MSM Volume V; B4-17 C.5.c). The planning error in this marine casualty is sub-categorized as a violation. Violations are defined in the Marine Safety Manual as “a deliberate decision to break established rules, procedures, or plans that are applicable to a specific problem regardless of the reason” (MSM Volume V; B4-19 C.7.c). Lastly violations are categorized into three (3) types of human error: (1) Routine Adaptation, (2) Exceptional Adaptation, and (3) Sabotage. The human error in this marine casualty was a Routine Adaptation. Routine Adaptations occur when individuals regularly modify or do not strictly comply with work procedures, often because of poorly designed or defined work practices (MSM B4-21 C.7.f).

The safe condition of the 480 volt receptacle was de-energized (switch indicator in the OFF position) with the receptacle door closed. The red safety placard over the 480 volt switch informed anyone working with that switch to make sure it was de-energized prior to opening the receptacle door for use. The Generic Error Modeling System classifies an error of not following the instructions as a planning error. [REDACTED] successfully plugged the electrical test lead into the receptacle, but because he did not de-energize the receptacle prior to opening the receptacle door, he committed a violation. The placard had directions to de-energize the receptacle before opening the receptacle door. [REDACTED] decided not to follow the directions printed on the placard. This disregard of the directions was not an attempt to cause damage, but rather is classified as routine adaptation.

Defense Factors

Defense Factors are guards against active failures and latent unsafe conditions. These factors can be available or undiscovered. Defense factors can also be in place or missing, and if they are in place they can be inadequate.

Defenses that were in place but failed due to inadequacy - Inadequate supervision:
Investigators found that during the test in the electrical workshop, [REDACTED] and Christopher Erickson did not have a clear idea of exactly what was being done. [REDACTED] was not familiar with the electrical test lead because he rarely worked in the electrical workshop. Yet, based on the supervisory relationship between the First Engineer and a Third Engineer, [REDACTED] was the senior person present in the electrical workshop and therefore the supervisor. In fact, [REDACTED] requested that Christopher Erickson assist him with replacing the circuit breaker. The knowledge and experience of the senior should be a layer of defense for preventing hazards. In this case, a safety observer was also required. During the evolution there was no documentation that a safety observer was ever established or assigned. As a result, the supervision of this test was inadequate.

Defenses that were in place but failed due to inadequacy - Inadequate engineered defenses: The original test leads for the electrical test panel were designed and installed by Hose-McCann. The original test leads had insulated alligator clips on the bare wire working ends. Subsequent investigation into test leads throughout the industry revealed insulated alligator clips are available and can be used as a primary connection. The insulation on the alligator clips is an engineered defense which can prevent the possibility of the hand or body contacting the bare wire working ends of the test lead. This non-standard test lead was a makeshift device created by the crew and did not have the insulated alligator clips. The cord was also six (6) feet in length thus permitting crewmembers to work with an energized cord even if not standing on the non-conductive matting (required by 46 CFR Part 111) positioned in front of the electrical test panel. The use of this piece of equipment reflected an inadequacy of an engineered defense and created a latent unsafe condition by exposing the bare working ends of the conductor and allowing crewmembers to step off of the safety matting. Therefore, the engineered defense for the test lead failed.

The only evidence of a properly working engineered defense in place was a red placard permanently affixed to the test panel that stated "De-energize prior to opening doors." This placard was located directly above the 480 volt receptacle's ON/OFF switch. On the interior molding of the switch, the ON/OFF positions are clearly displayed.

Defenses that were in place but failed due to inadequacy - Inadequate briefings: As discussed previously, evidence revealed that at no point during the testing evolution was a job hazard analysis or new work permit created to confirm all personnel doing the work knew the entire scope of the work being conducted. An interview with [REDACTED] suggests that he went over basic electrical safety and an overview of how to connect the undervoltage release solenoid to the test lead with Christopher Erickson. It was also revealed that as [REDACTED] inserted the four (4) prong plug end of the test lead into the receptacle, [REDACTED] noticed the switch appeared to be in the tripped position. [REDACTED] decided that he would test the electrical supply line to determine if the receptacle was energized. This was not the original job that was briefed from [REDACTED] to Christopher Erickson.

This incident may have been prevented by a thorough briefing. S/R WILMINGTON's Safety Management System required its personnel to conduct a Safe Performance Self-Assessment (SPSA/Take 5) prior to conducting work. The SPSA/Take 5, Safety Management System Procedure 04-A-03-005, entitled "Loss Prevention System," required personnel to also conduct a Job Hazard Analysis (JHA) since the "consequences of failure are severe." There is no evidence a new briefing (SPSA/Take 5 or JHA) was conducted by anyone working in the electrical workshop. An appropriate SPSA/Take 5 would have made the engineers discuss how to correctly test the electrical supply line. The void of information created by an inadequate or absent "briefing" is a latent unsafe condition.

Defenses that were in place but failed due to inadequacy - Inadequate training: S/R WILMINGTON's Safety Management System did not have specific instructions, policy, procedures or standing orders covering the complete safe operation of the electrical test panel in the electrical workshop. S/R WILMINGTON's Safety Management System did, however, have safe work practices for working with live or potentially live circuits. Additionally, S/R WILMINGTON's Safety Management System procedures for working

with live circuits required engineers to wear personal protective equipment. Throughout all interviews, the crewmembers stated that in the electrical workshop, when conducting electrical tests, they did not create test specific work permits, use the procedures for working with live or potentially live circuits, and did not wear personal protective equipment.

During an interview with [REDACTED] and in a written statement, the Chief Engineer defined the safe way to connect the test lead to the undervoltage release solenoid. Through [REDACTED] experience as a Chief Engineer, he created the process, but the process he discussed was never provided as written instruction to new crewmembers or used as a training tool for the safe operation of the test panel. Of note, the process [REDACTED] created did not include wearing personal protective equipment. This evidence further affirms that engineers had historically worked with live circuits in the electrical repair shop without wearing personal protective equipment. This work description is contrary to the procedures written in the vessel's Safety Management Systems. This evidence also reflects an inadequacy in the way S/R WILMINGTON personnel were trained to work with the electrical test panel in the electrical workshop.

Defenses that were in place but failed due to inadequacy - Improper or inadequate personal protective equipment: All engineers working at the electrical test panel were working bare-handed, not wearing electricians' gloves. S/R WILMINGTON's Safety Management System identified electricians' gloves as required personal protective equipment when working with live circuits. The absence of the required personal protective equipment created a latent unsafe condition.

IV. CONCLUSIONS

The causal analysis of this personnel casualty led the investigation team to the following five (5) conclusions.

Conclusion 1: The First Engineer, [REDACTED], violated the ship's rule.

The First Engineer, [REDACTED] violated the ship's rule (red safety placard) by not following the instructions on the placard above the 480 volt switch on the Electrical Test Panel; not conducting a new job hazard analysis after changing personnel; not wearing personal protective equipment; and not communicating a hazard to other personnel in the electrical workshop under his supervision. Based on the marine casualty analysis, it can be seen that the red placard above the 480 volt switch acted as a defense. The intent of the placard was to prevent employees working in the workshop from attempting to use the 480 volt receptacle when it was energized. [REDACTED] made the decision to plug the test lead into the receptacle without confirming that the receptacle was de-energized. Based on the definition of routine adaptation, an action is done because it is an easier action than the prescribed action, the action is done frequently, and the environment is forgiving. [REDACTED] a twenty (20) year licensed Chief Engineer (he was sailing as a First Engineer on the S/R WILMINGTON due to employee cutbacks within SeaRiver Maritime) considered plugging the cord into a receptacle an easy or routine task to perform. Seeing it as such a routine task, [REDACTED] knew the easier way to plug the test lead in was to open the receptacle door and plug it in instead of taking the extra step to de-energize the receptacle.

The S/R WILMINGTON did not have specified procedures or policies in place for operating the electrical test panel. Without specific procedures for using the electrical test panel, it can be inferred, the procedures for conducting electrical work identified in the Safety Management System applied to the procedure.

Investigators found no documentation or evidence that [REDACTED] conducted the transfer of responsibility or the new Job Hazard Analysis. Chapter 4 of S/R WILMINGTON's Safety and Health Manual states:

If the time required for the work necessitates a change in personnel, a Job Hazard Analysis shall be conducted with the relief personnel. If this change involves the person who performed the tagging, transfer of responsibility shall be carried out in accordance with 04-A-04-085.

[REDACTED] failed to wear personal protective equipment, including the required electrician's gloves. Chapter 4 of S/R WILMINGTON's Safety and Health Manual states:

Work Performed On Energized Circuits, the following rules apply:
Testing and checking energized equipment and circuits may be performed with instruments where it is necessary to have the circuits energized. Only those knowledgeable in using electrical testing equipment shall be permitted to test electrical circuits. Where energized circuits may be involved, the one doing the testing shall wear electrician's gloves, and depending on the circumstances use other protective devices, such as rubber blankets, to protect against inadvertent contact with energized components. (See E-6 for approved types of electrical insulating gloves. Guidelines for the use and inspection of electrical gloves appear at the end of this procedure.)¹⁶

Furthermore, [REDACTED] violated the ship's Safety Management System by not communicating a perceived hazard to the rest of the individuals working in the workshop. Based on [REDACTED] own statements during interviews, he did not know if the receptacle was energized. S/R WILMINGTON's Safety Management System states, "...all circuits are to be treated as live until verified otherwise..."¹⁷ Based on this policy, the test lead should have been identified as a live circuit, treated as live, and [REDACTED] as the senior officer in the electrical workshop, should have ensured the circuit was treated as live.

During the course of this investigation, sufficient evidence of an apparent violation of 46 CFR 5.27 and potentially 46 CFR 5.29, was discovered to warrant referral for enforcement evaluation. Final evaluation and agency action on this evidence will be reported separately.

¹⁶ S/R WILMINGTON Safety Management Procedure 04-A-04-065, page 3 of 6.

¹⁷ S/R WILMINGTON Safety Management Procedure 04-A-04-065, page 1 of 6.

Conclusion 2: The Third Assistant Engineer, Christopher Erickson, accepted an unnecessary risk.

Christopher Erickson placed himself in a hazardous situation by picking up the makeshift electrical test lead (not treating the circuit as live); by not ensuring a proper job hazard analysis was conducted; and by not wearing personal protective equipment.

Christopher Erickson was a licensed engineer and a graduate of the Massachusetts Maritime Academy. While at the Massachusetts Maritime Academy, he completed the Standards for Training, Certification and Watchkeeping (STCW) requirements and, because of his outstanding performance, was awarded the rank of Cadet Chief Engineer. Christopher Erickson was hired by SeaRiver Maritime on June, 25, 2007 and records of shipboard training reflect he had sailed on the S/R WILMINGTON for approximately one year and six months. As discussed earlier, he routinely worked in the electrical workshop repairing deck flood lights. Furthermore, a full indoctrination to the Safety Management System is mandatory for all new crewmembers and investigators received written documentation that Christopher Erickson was trained on the Safety Management System requirements. He was a highly intelligent and capable engineer expected to be familiar with engineering safe work practices.

Christopher Erickson, as a licensed Third Engineer, was responsible for being cognizant of all of the safe work practices for the electrical workshop. STCW is one of the standards that a Third Assistant Engineer needs to earn a license (an excerpt is attached as Enclosure 2). STCW requires competence of marine engineering at the operational level (STCW Table A-III/1). This competence includes: “Use appropriate tools for fabrication and repair operations typically performed on ships.” Additionally, the engineer must have knowledge, understanding and proficiency of the “...application of safe working practices in the workshop environment...” Based on the requirements of STCW for Christopher Erickson’s Third Assistant Engineer license, he should have known the potential hazard he was working near. Christopher Erickson had historically worked on circuits live or otherwise, and based upon his length of service onboard the S/R WILMINGTON; he should have been familiar with the Safety Management System procedures for working with live circuits. Furthermore, he should have taken the appropriate precautions to guard all personnel against hazards in the electrical workshop.

By picking up the makeshift electrical test lead without wearing personal protective equipment, Christopher Erickson did not treat the electrical test lead as a potentially live circuit. As discussed earlier, the S/R WILMINGTON Safety Management System identified electrical energy as a hazard. The Safety Management System states, “Work on electrical circuits requires a higher degree of attention due to inherent dangers that can result in serious burns or fatalities.”¹⁸ Based on the recognition of this hazard, the Safety Management System established that when working on a circuit that could possibly become energized, the circuit is to be treated as energized.

The “Work Performed On Energized Circuits” section of S/R WILMINGTON’s Safety Management System states, “Work on energized circuits is an exception to standard operating procedures and should only be performed after a careful review of the job is

¹⁸ S/R WILMINGTON Safety Management Procedure 04-A-04-065, page 1 of 6.

made, and if no safer alternative can be utilized.”¹⁹ No evidence was provided to indicate a careful review of the job was made, nor was there a discussion of a safer alternative. Christopher Erickson knew he was going to be working with or near a circuit that had the potential for becoming energized. Therefore, based on the Safety Management System, each engineer was responsible for wearing electrician’s gloves. In addition, the Safety Management System identifies “testing” as having a high potential for exposure. The scope of the job being performed by Christopher Erickson and [REDACTED] was a “testing” job to be performed on the undervoltage release solenoid for the new circuit breaker and should have been conducted with a higher level of safety in mind.

It appears that a generally accepted practice to disregard the Safety Management System and not wear personal protective equipment, for example, while conducting work in the electrical workshop had been inculcated into the culture of SeaRiver Maritime before Christopher Erickson reported onboard.

Conclusion 3: A major non-conformity existed in the S/R WILMINGTON’s Safety Management System prior to this marine casualty.

As previously outlined in the Organization Section of this report, based on the objective evidence collected and reviewed and by definition, all of the requirements of a Safety Management System major non-conformity were met: “an identifiable deviation which poses a serious threat to personnel or vessel safety or a serious risk to the environment and requires immediate corrective action; in addition, the lack of effective and systematic implementation of a requirement of the International Safety Management Code.”

Identifiable deviations from the International Safety Management Code and Safety Management System which posed a serious threat to personnel existed onboard the S/R WILMINGTON and these deviations required immediate corrective action.

Enclosures 9 through 14, particularly the OCMI’s determination letters of May 27, 2009 and July 14, 2009, provide a comprehensive analysis of the Safety Management System major non-conformity that represented an identifiable deviation from the ISM Code and posed a serious threat to personnel onboard the S/R WILMINGTON.

Conclusion 4: The U.S. Coast Guard does not have regulations that specifically require electrical safe work practices or personal protective equipment to protect mariners against electrical hazards.

Currently, there are no U.S. Coast Guard Regulations specifying requirements for Electrical Safe Work Practices and personal protective equipment onboard inspected vessels. OSHA has regulations for safe work practices and personal protective equipment and these rules apply to public vessels operating on navigable waterways, in addition to land-based work. In the attached Enclosure 3, Coast Guard investigators created a spreadsheet that outlines possible gaps between OSHA regulations for electrical work and the U.S. Coast Guard’s electrical engineering regulations found in 46 CFR Subchapter J.

¹⁹ S/R WILMINGTON Safety Management Procedure 04-A-04-065, page 3 of 6.

S/R WILMINGTON's Safety Management System included sections of OSHA's electrical safety requirement; however, the company, vessel and crew but did not apply those requirements in the electrical workshop. The intent of the Safety Management System was to implement safeguards against these hazards.

A safeguard was available to prevent engineers from potentially being shocked. This safeguard was Personal Protective Equipment (non-conductive sleeves, gloves, and hoods). SeaRiver Maritime's Safety Management System identified the potential hazard of working with or near circuits that are live, or may become live. Unfortunately, it was interpreted by the S/R WILMINGTON's crew that Safety Management System procedures allowed for circumstances that would not mandate the wearing of the necessary personal protective equipment. The testing of equipment inside the electrical workshop was one of these perceived circumstances. In this case, there is strong evidence to conclude that there should be no circumstances where the removal or non-requirement of personal protective equipment should be authorized when working with an identified or potential hazard. OSHA has specified requirements for personnel protection equipment in 29 CFR 1910.335. The regulation states:

(a) Use of protective equipment--(1) Personal protective equipment. (i) Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed. (ii) Protective equipment shall be maintained in a safe, reliable condition and shall be periodically inspected or tested, as required by Sec. 1910.137. (iii) If the insulating capability of protective equipment may be subject to damage during use, the insulating material shall be protected. (For example, an outer covering of leather is sometimes used for the protection of rubber insulating material). (iv) Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized parts. (v) Employees shall wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion. (2) General protective equipment and tools. (i) When working near exposed energized conductors or circuit parts, each employee shall use insulated tools or handling equipment if the tools or handling equipment might make contact with such conductors or parts. If the insulating capability of insulated tools or handling equipment is subject to damage, the insulating material shall be protected.

S/R WILMINGTON's Safety Management System does not align with this regulation. Therefore, MSU investigators were able to conclude that a full alignment with the OSHA regulations may have prevented this marine casualty.

From the Federal Register, to the shipping regulations for inspected vessels under 46 CFR, to the references incorporated by those regulations, none of the mentioned documents contain prescriptive recommendations for safe electrical work practice onboard inspected vessels. During the investigation, MSU investigators met with an OSHA Compliance Assistance Specialist to discuss OSHA requirements for safe electrical work practices. In reviewing the OSHA regulations, investigators found the following regulatory guidance that applies to shore-side personnel and on public vessels under OSHA's jurisdiction:

Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized. The specific safety-related work practices shall be consistent with the nature and extent of the associated electrical hazards.²⁰

Based upon a review of OSHA regulations and the results of the causal analysis, it can be concluded the OSHA electrical safety regulations applied to the electrical workshop would have been an added and effective layer of protection against the hazard at the root of this casualty.

Conclusion 5: The existing Alternate Compliance Program does not provide adequate oversight of Authorized Organizations and is not completely effective in achieving one of the Coast Guard's primary missions of preventing the loss of life.

The Alternate Compliance Program allows third party classification societies to issue inspection and safety certificates on behalf of the U.S. Coast Guard. These third parties are influenced by market forces, conducting random samples as opposed to full inspections and competing with other classification societies in an effort to raise their market share; often encounter conflicts of interest while carrying out public functions on the basis of a private contract; and are dependent upon the vessel owners and operators to report damage and Safety Management System non-conformities.

There is also a lack of clear guidance to both the maritime industry and Authorized Organizations in regards to what constitutes Safety Management System non-conformities and major non-conformities, post-casualty reporting requirements, and after action responsibilities of the Authorized Organization. In the absence of clear guidance and oversight, companies may simply not report unsafe conditions and, in turn, classification societies may not inquire into safety practices during their limited, random audit process. Without adequate oversight and clear guidance, this system will permit unsafe conditions to become inculcated into the vessel's shipboard practices, and may ultimately result in the loss of life.

V. RECOMMENDATIONS TO THE COMMANDANT OF THE UNITED STATES COAST GUARD:

1. It is recommended that Occupational Safety and Health Administration electrical safety rules be adopted to improve electrical safety procedures, installations and operations onboard U.S. inspected vessels.
2. It is recommended that the U.S. Coast Guard revise guidance to Authorized Organizations and the maritime industry regarding the implementation and auditing of Safety Management Systems onboard U.S. inspected vessels. This guidance should clearly outline for the maritime industry and Authorized Organizations what actions, conditions and incidents constitute Safety Management System non-conformities and major non-conformities; the required scope of third party audits; marine casualty reporting

²⁰ 29 CFR 1910.333

requirements to third parties; and required follow-up audits and actions to address the causes of marine casualties.

3. It is recommended that the U.S. Coast Guard require companies participating in the Alternate Compliance Program to immediately report deaths and injuries onboard their vessels to their authorized classification societies and to subsequently request an audit of the Safety Management System to determine if non-conformities contributed to the loss of life or injury.

4. It is recommended the U.S. Coast Guard reexamine the Alternate Compliance Program to ensure the currently accepted system of third party oversight and the Coast Guard's implementation of the program provides an equivalent level of safety as a full regulatory vessel inspection.

5. It is recommended that the U.S. Coast Guard provide clear direction to Authorized Organizations requiring the inspection and auditing of installations that require crewmembers to work with hazards identified by the approved Safety Management System.

6. It is recommended that the U.S. Coast Guard fully train and qualify marine inspectors to provide adequate oversight of Authorized Organizations and third party auditors.