National Transportation Safety Board
Office of Research and Engineering
Washington, D.C. 20594

Fire Factual Report
February 23, 2006

A. Accident Information

Accident No: DCA05MM002
Date: October 17, 2004
Location: Port Richey, FL in the Pithlachascotee River
Vessel: Shuttle Express II
Owner/Operator: Paradise of Port Richey Inc./Port Richey Casino

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B. Accident Summary

On October 17, 2004, at about 1020, the U.S. Small Passenger Vessel Express Shuttle II was

returning to the company marina in Port Richey, Florida when a fire broke out in the engine room. There was one Master and two deckhands on board. After attempting to extinguish the fire with hand-held fire extinguishers, the crew realized that the fire was out of control and all three were rescued by passing recreation boats. One crewmember sustained smoke inhalation and was treated and released from a local hospital.

The fire destroyed the entire vessel and was later declared a total loss by the underwriters. The vessel's insured value was $800,000.

Events Preceding the Accident

On the night before the accident, another master had to place the #4 high-pressure fuel line on the starboard engine. This line is located on the outboard side of the engine. As he transited from Port Richey and made his approach to the larger vessel, the master noticed a loss of power on the starboard engine, and from his past experiences with this particular vessel, he surmised that a high-pressure fuel line was leaking. The master also mentioned that he had replaced high-pressure fuel lines on this engine before. There were no reports of similar repairs taking place on the port engine. The Port Captain for the company indicated that this is a unique problem to Caterpillar engines since the high-pressure fuels lines are external to the engine.

The master told investigators that he completed the repairs at about 2000 while alongside the gambling vessel. He returned to the marina and made one more round trip for the shift, without incident.

Accident Narrative

The Express Shuttle II's normal operation was in shuttling passengers from a marina in Port Richey Florida to a gambling vessel off anchored three miles off the coast of Florida. After the passengers are transferred from the shuttle vessel to the larger gambling vessel, the larger vessel transited to a position nine miles off the shore where gambling becomes legal.

On the morning of the accident, the Express Shuttle II departed the marina between 0700 and 0730 and transported the large gambling vessel's crew and casino employees to the vessel. The shuttle returned to the marina and boarded 78 passengers for the trip to the gambling vessel. The shuttle departed at 0930 and arrived at the larger vessel in about thirty minutes[1].

The shuttle disembarked the passengers and got underway to return to the company marina. According to the master, he reported no problems with the engines until he neared an area in the channel referred to as the "S" turn. As the master neared day marker "10A", he reduced both engines to idle to reduce the forward momentum in preparation for entering a "no-wake" zone on the entrance to the river. Moments after the reduction, the starboard engine surge to full throttle and returned to

[1] The exact times could not be determined because the vessel log was destroyed in the fire.

idle. Seconds later, the starboard engine surged again to full throttle, and then shut down, thereby causing the master to lose propulsion on the starboard shaft. Using only the port engine to make the turn at marker 12, he began the turn when one of the deckhands came into the wheelhouse and informed the master that there was smoke coming from the engine space. The captain continued to maneuver the vessel towards shallow water to the starboard side of the channel with the intention of beaching or grounding the vessel. Moments later, the master said that he lost the port engine and was unable to maneuver the vessel. At this point, the second deckhand came to the vessel wheelhouse and informed the master that the fire was not controllable. The master told investigators that he did not hear the audible alarm, nor see the visual indicator lights for smoke detectors.

According to the senior deckhand, he and the other deckhand had completed their assigned cleanup tasks in preparation for the next load of passengers when he heard a "grinding noise." He then saw white smoke coming from the smaller engine hatch, slightly astern of the main engines. He and the other deckhand went to the hatch located aft of the engines and lifted the hatch. Smoke came billowing out of the hatch. He told the other deckhand to inform the master while he retrieved an extinguisher.

The second deckhand returned and both deckhands moved the tables and chairs that covered the main access hatch over the starboard engine. The second deckhand attempted to lift the hatch while the senior deckhand attempted to discharge the extinguisher into the space. Flames and heavy black smoke erupted from the space and the deckhand dropped the hatch closed. The senior deckhand told investigators that he went to the wheelhouse and informed the master that the fire was out of control. Neither deckhand was aware that there was a fire extinguishing system in the engine room or how to operate it. The master returned with the deckhand and upon seeing the smoke, went forward to uncoil and deploy the fire hose. The master admitted that he forgot that the fire pump ran off the main engines and that he would not have been able to use the hose. There was no mention of electrical problems on-board prior to the fire.

Emergency Response

The City of Port Richey Fire Department (PRFD) dispatchers received a 911 call notifying them of a fire on board a SunCruz shuttle but the caller gave no exact location[2]. The first arriving engine company initially responded to the SunCruz dock unaware that the vessel was not there. One of the firefighters noticed a big column of black smoke on the river in the distance with a helicopter circling in the vicinity. The smoke column appeared to be in the area of Harbor Point, which is the most western point of the city limits accessible by roads. Additional calls into the dispatcher confirmed this as the accident location. After arriving on scene, the Port Richey fire captain observed that the vessel appeared to be aground and the entire deck structure was involved in fire. He requested an engine from Pasco County when he saw the extent of the fire[3]. The firefighters pulled hoses and set up on a private citizen's lawn and hoses and equipment were passed over a garden and patio wall to access the beach. Ladders were also set up along the wall to facility entry to the beach. Initially, firefighters were going to

[2] The Port Richey Fire Department's jurisdiction includes everything within the city limits and 9 miles out into the water.

[3] All apparatus and responding units were on the same tactical radio channel for communications.

try to walk out to the boat since it was low tide but were advised that the water was too deep where the vessel was grounded. At this time, the PRFD captain was advised that the Port Richey police boat was on its way. The captain looked up and saw the Pasco Sheriff's office boat, Marine 3, in the water. Port Richey Fire Department does not have any fireboats.

Port Richey FD was also advised that there had been 3 people on the vessel and that they had been removed. A Pasco County Rescue unit was responding to pick up any injured crewmembers from the vessel. There were conflicting reports given to the rescue unit as to the location of the crewmembers and to how many patients there were. Marine 3 advised the rescue unit that the 3 crewmembers had been removed from the scene in another boat and taken to a dock near the SunCruz dock. At some point, the captain of the vessel contacted the Port Richey fire captain to tell him to shut off the fuel supply to the engine to keep the boat from sinking. The PRFD captain told the vessel captain that he didn't think the firefighters would be able to access the fuel shutoff.

Upon arrival of a battalion chief from Pasco County, PRFD turned command of the scene over to him as other fire apparatus arrived from Port Richey and Pasco County. The PRFD captain, a Pasco Co. FD captain and another firefighter pulled the hose lines out the shore and boarded Marine 3 with all their equipment. Marine 3 took the firefighters to the boat. The decks of the Shuttle had started to collapse at this time. The firefighters boarded the Shuttle Express and started fighting the fire. Firefighters attempted to extinguish the fire from Marine 3. However, the pressure from the hoses pushed Marine 3 away from the Shuttle Express.

They started putting water on the fire. There were holes in the deck beneath their feet and the firefighters noticed fire in the spaces below them so they started adding water to the fire below. Marine 3 took the firefighters to the Shuttle in shifts. The first attack on the boat had 3 firefighters. The most firefighters on the boat at one time were 4 firefighters coming off and 4 coming on.

The FD were unsure whether the fuel tanks were involved in the fire so they decided to try and extinguish the fire with foam to try and bring the fire under control. The firefighters decided that they would not be able to use portable foam tanks and discharge from the vessel. This was due to the long distance the hoses were from the engine and the Instead, the foam was added to fire engine tanks and discharged from the engine. The fire was contained at 1118. The fire was extinguished around 1500. The engines were still steaming and hot even after the fire was under control. The firefighters were cleaning up their equipment when they heard over the radio that the vessel was being towed to Tarpon Springs. There were no injuries to firefighters.

The Port Richey Fire Department had training in firefighting with boats in a marina, but has not participated in any drills involving vessels out in the water. No training has been done with the Coast Guard but PRFD does do training drills with Pasco County FD, Pasco Sheriff's Department and Port Richey PD.

C. Vessel Information

The Express Shuttle II was a 65-foot fiberglass monohull with twin diesel engines. It was built in 1997.

Vessel Propulsion and Machinery Plant

The propulsion plant consisted of 2 Caterpillar model 3408 turbocharged and aftercooled main diesel[4] engines, each capable of producing approximately 80 horsepower. Each engine was direct-coupled to its respective side shaft and 4-blade propeller. According to the manufacturer, the average external surface temperature for this model of engine is 180°F.

For vessel power generation, the Express Shuttle II was outfitted with 2 Kubota AC generators, each rated at 21 kilowatts output. During normal vessel operation, only one generator was running at a time.

Transmission

Spin Disc manufactured the transmission drives. The transmission model number was MG-5114 SC. The Spec. Number was S-9621. The ratio was 2.04:1

Starboard Engine Fuel Line Failures

The master who encountered the leaking fuel line Saturday night before the next day's accident stated that this was the third time in the past 6 months that he had changed out a failed high-pressure fuel line on that same engine. He went on to say that other company masters had indicated that they had had the same problem starboard engine and failing high-pressure fuel lines.

In subsequent interviews with other company personnel, all but one of the other employee had themselves changed, or assisted someone in changing, a failed fuel line on that same starboard engine. The only individual that had not changed or assisted in changing a fuel line had only been with the company approximately 3 weeks at the time of the accident.

D. Wreckage Description

The damage to the Express Shuttle II resulted in the vessel being declared a total constructive loss. The fire destroyed the entire vessel from the top deck through the main deck[5]. A section of the port outboard cabin bulkhead had been charred by the fire but was still intact. The destroyed sections of the upper decks collapsed on to the main deck and into the bilge and engine compartments.

[4] According to the MSDS from the fuel supply service, diesel fuel had a flash point of 130-190°F, and an auto-ignition temperature of 637° F.
[5] See Figure 1.

Wooden components were heavily charred and partial consumed. Fiberglass components were brittle with most of the resin burned out of the structure. A large portion of the main deck had been burned through especially in the area of the engine compartment. All items located on the main and upper decks (chairs, tables and other miscellaneous items) were also completely destroyed.

Figure 1: Portside view of the Shuttle Express II after the fire.

Engine Compartment

The engine compartment was heavily damaged by fire. Both engines and the vessel's generators were destroyed in the fire. Both engine covers were heavily fire damage. The side of the engine cover facing the engines was more damaged than the side facing away from the engines particularly along the centerline. The starboard side of the cover was more damaged than the port side.

Engines

The concentration of the damage on both engines was more intense on the inboard side of both engines. The starboard engine was more severely damaged than the port engine.

Port Engine

The port engine had a pulley drive for the fire pump. Inboard, all aluminum components of the engine particularly the turbocharger were melted or damaged. The compressor side housing for the inboard turbocharger was melted but the impeller was intact. The exhaust sides of both turbochargers were intact. The air intake shutoff arm was in the "on" position. All of the fuel lines on the port engine were intact and appeared properly clamped to the engine block.

The electrical system for the engine was heavily damaged in the fire. However, there was no evidence of arcing found on the remaining wires.

Starboard Engine

On the inboard manifold, the fuel delivery line (as shown in Figure 4) to the #5 injector from the front was broken at the fuel delivery pumped end[6]. The fracture occurred at the ferrule for attaching the fuel injection line to the fuel pump manifold[7]. The #5 fuel injection line was not clamped to the engine block or to another fuel line. The Caterpillar Service Manual for 3408 and 3412 High Performance marine engines stated that the clamps for the fuel injection lines should be installed in the correct location. Incorrectly installed clamps may allow the fuel lines to vibrate and the damaged lines may leak and cause a fire.

One loose unattached clamp was found in the vicinity of the broken fuel line on the engine block. The clamp was found in the unscrewed (open) position. None of the other fuel injector lines were clamped to the engine block, although, some were clamped to each other[8]. On the inboard turbocharger[9], the compressor side housing and impeller were destroyed with only a small amount of melted impeller remaining[10]. The impeller for exhaust side of the inboard turbocharger was intact. The aluminum housing for the outboard turbo charger had melted but the compressor side impeller and the exhaust side impeller were both intact. The exhaust gas manifold, which provides exhaust gas pressure to propel the turbocharger, was also intact[11]. The air intake shutoff arm was in the "on" position. The fine fuel filters, located on the inboard side of the engine, were destroyed. The inboard valve covers were melted. The outboard fuel lines were intact but not clamped to the engine block. The starboard engine had a pulley pump drive for the bilge pump.

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[6] The operating pressure at the fuel injector head (valve opening pressure) for these high-pressure fuel lines is 1800 psi.

[7] For a detailed examination, see the Materials Laboratory Factual Report-Report No. 04-138.

[8] During the laboratory examination, two other fuel injector lines, Lines #1 and #3, were worn through a portion of their diameter.

[9] Most of the engine surfaces, including the turbocharger housing, are water-cooled and are not to exceed 400°F. The average temperature of water-cooled surfaces is 180°F according to the engine manual.

[10] See Figure 2.

[11] The average internal operating temperature of the exhaust gas manifold is 1065°F according to the manufacturer. This manifold is not water-cooled. See Figure 3 for location of manifold.

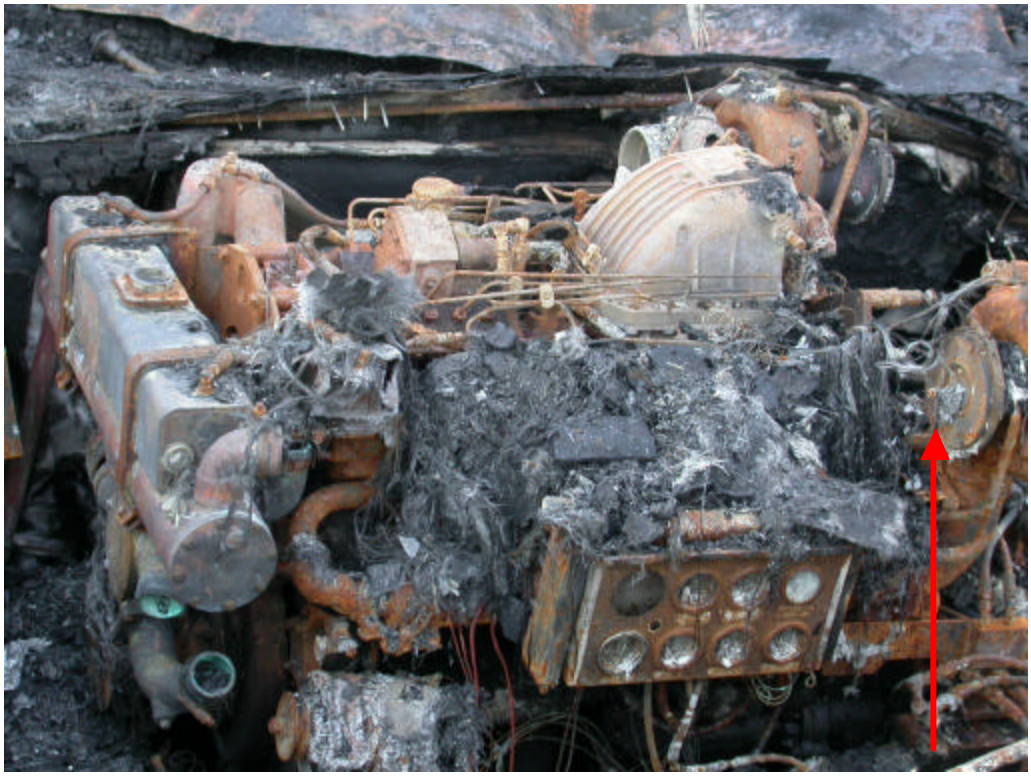

Figure 2: Starboard engine.

Figure 3: Starboard engine aft section.

The electrical system for the engine was heavily damaged in the fire. However, there was no evidence of arcing found on the remaining wires.

Figure 4: High-pressure fuel lines for starboard engine.

Generators

Port Generator

The inboard aluminum components were melted. The unit was fire damaged but intact. There was no evidence of mechanical damage not associated with the fire.

Starboard Generator

The front and inboard sides of the generators were heavily damaged. Aluminum components in this area were missing or melted. The back and outboard sides of the unit were damaged by heat but not as severely as the inboard and front sides. There was no evidence of mechanical damage not associated with the fire.

All electrical wiring that could be accounted for showed no evidence of arcing or pre-fire

damage.

Transmission

There were no reported problems with propulsion or steering during the accident. There was no significant damage to either transmission.

Fire Protection Systems

Fire Suppression System

Title 46 Part 181 Section 400 of the Code of Federal Regulations (46CFR181.400) requires a space containing propulsion machinery to be equipped with a fixed gas fire extinguishing system. The fire suppression onboard the Express Shuttle II was a custom engineered, manually operated carbon dioxide system[12]. The system was installed during original construction of the vessel in 1997. USCG Marine Safety Office approved the design of the extinguishing system. The last maintenance on the system was the yearly maintenance and inspection, which was done in May 2004. Original drawings were found in the vessel file.

The system consisted of a 100 pound cylinder of carbon dioxide (CO_2) located in a compartment forward of the fuel tanks[13]. According to the information in the vessel file, the system had an operating pressure of 2,500 pounds per square inch (psi). Calculations in the system information indicated that to flood the 1,460 square foot engine room, 91.4 pounds of carbon dioxide were required[14].

Three actuation devices were located near the cylinder below the main deck level. A hatch covered the system actuation devices and gas cylinder. In order to access the actuation devices, a person would have to enter the space through the hatch. To begin the discharge of the system, the pin and lever, located on the top of the cylinder, would have to be pulled to open the cylinder. There is also another pin and lever device located on the stop valve next to the pressure switch that will also open the cylinder. The two levers, the one on the cylinder and the one of the stop valve are mechanically interconnected. Once the gas was flowing, a pressure switch would activate, shutting down the engines and ventilation into the engine space. A thirty-second time delay, controlled by a delay valve, takes place before the CO_2 would be released into the engine space. No discharge will pass through the elbow to the 30- second delay valve until the engines and ventilation switch is actuated. A third device

[12] Custom engineered fire suppression extinguishing systems are systems that are specifically designed for an individual vessel's engine room. A system is designed to meet the needs of that particular space and the system is built with approved components.
[13] The last hydrostatic test for the carbon dioxide tank on-board the Shuttle Express II was performed in 2000.
[14] See Appendix A, Figures 1A, 1B and 2A, for diagrams and photograph of the fire suppression system layout.

was installed in the system that, if pulled, would by-pass the time delay and immediately discharge the CO_2 into the engine space. Galvanized steel piping extended from the cylinder aft to the engine compartment and terminated in two bell shaped discharge nozzles. One discharge nozzle serviced each engine, however both nozzles would discharge simultaneously once the system was activated. Suncoast Fire Safety Inc, a third party, inspected and provided any needed maintenance on the system annually. Suncoast would submit an inspection report to the owner upon completion of the yearly inspection and this report would then be submitted to the Coast Guard as part of the annual Coast Guard inspection.

The cylinder, piping and bells were accounted for during the post accident examination. The pins and release levers were intact on the cylinder. All components exhibited heat damage. The cylinder had released its contents prior to examination due to exposure to heat and over-pressurization through the safety valve.

The master was aware that a fire suppression system was onboard. He was familiar with the location of the release lever and the procedures to follow in case of fire. The deckhands were not aware of the presence of the suppression system prior to the fire and were not instructed in its use. The master on duty stated that the system was not activated. This was due to the inability to access the lever due to smoke conditions.

Fire Detection System

In accordance with 46CFR181.400, a space containing propulsion machinery is required to be equipped with a fire detection system of approved type. The fire detection system onboard the *Express Shuttle II* was a custom designed and built system comprised of a control panel manufactured by Aqualarm with detectors (both smoke/heat and heat) wired directly to the panel. Diagrams of the panel and control board layout were found in the vessel file. A detector layout schematic was found on the original blueprints[15]. However, no wiring diagrams were found. The system was installed during original construction of the vessel in 1997. At the time this system was installed, the system was approved under a "Type Approval." Under "Type Approval", as long as the components were approved, a system made entirely from approved components was also approved. To be an approved component under the regulations, a component must be Underwriter Laboratory (UL) approved for that specific use in this case, for use in a fire detection system. However, while the Aqualarm panel had a UL approval for use as an electronic component, it was not UL approved for use in a fire detection system. As of November 2004, Aqualarm is no longer type approved by the Coast Guard.

A typical fire alarm system configuration would include wiring coming from the panel and connecting to an initiating device (detector). Depending on the number of devices, the initiating devices with in a "zone[16]" are then connected to each other in parallel if there are multiple detectors in a zone. An end of line device is attached at the end of a circuit to "supervise" the circuit.[17] 46CFR161.002-10

[15] See Appendix A, Figure 3A for fire detection layout diagram.
[16] According to 46CFR76.27-5, a fire detection system shall be divided up into separate zones to restrict the area covered by any particular alarm signal.
[17] An end of line device is an electrical device, usually a resistor that monitors power through a system. In a

requires circuits extending from a control unit to the fire detectors of each zone to be electrically supervised.

On the *Express Shuttle II*, the installed fire alarm system was designed and installed to always be in operation and powered, either by ship system or system emergency power. A 10-ampere inline fuse at 12 volt (V) was installed to protect the system. The fuse was located under the wheelhouse dash directly below the alarm panel.

The monitor alarm panel was a custom panel containing 6 visual indicator lights[18]. The alarm panel was located on the console in the pilothouse. Each light indicated an individual zone. On this vessel, one detector serviced each zone. These zones were as follows:

1) Lazarette
2) Engine Room
3) Fuel Room
4) Forward Stowage Space
5) Forepeak
6) Galley[19]

These lights indicated the status of the individual detector in that zone. Each zone was equipped with a smoke/heat detector[20] with the exception of the engine room, which had heat detectors[21]. According to the original design, the engine room was to have multiple detectors wired in parallel. The Port Captain for SunCruz could only recall one detector located in the back of the engine room, between the starboard engine and the starboard generator. The alarm was 110 decibel (db), 12V horn siren[22]. The siren is triggered by the energized monitor panel in the event of a smoke or heat detector activation. The detectors installed were Underwriter Laboratories (UL) approved, 2 wire, 12V smoke detectors with auxiliary relays[23]. The detectors were locally sounding. The control panel provided the power for the detectors[24]. According to Aqualarm, the initiating devices were wired to have a single connection to

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supervised circuit, the resistor, usually installed in the farthest point from the alarm control unit, restricts the flow of current to a known value. The panel monitors this resistance. If there is a change in the flow of current due to the activation of a detector or loss of power in the system, it creates a change in the resistance and this is registered at the panel and the panel alarms.

[18] Title 46 Part 161 Section 002-10 of the Code of Federal Regulations (46CFR161.002-10) requires a fire detecting system control unit to consist of a drip-proof enclosed panel containing visible and audible fire alarm signaling devices, visible and audible trouble alarm devices, visible and audible power failure alarm devises, power supply transfer switch, charging equipment when employed and over-current protection for power supplies.

[19] This smoke detector was located on the main deck.

[20] This type of detector was capable of functioning as both a smoke (photoelectric) detector and a heat (ionization) detector. According to the drawings, the original installation was done with Sentrol ESL 449CRT model smoke detectors.

[21] According to the drawings, the engine room was equipped with Aqualarm remote fire detectors.

[22] The information on the110 db horn siren came from a letter to the Coast Guard from the ship builder. The system diagram lists the audible alarm being provided by a 90-db alarm bell.

[23] An auxiliary relay is used to activate other devices such as elevator recall, door holders and strobes.

[24] 46CFR161.002-10 requires circuits extending from a control unit to the fire detectors of each zone to be electrically supervised.

the panel, leaving the circuit "open" or unsupervised[25]. The repair technician verified this was the design on-board. There was no indication in the original documentation that end of line devices were installed.

Prior to the accident, repair work was done on the system October 5, 2004. Two smoke/heat detectors were replaced in the galley and fuel room. The original maintenance request was for the damaged detector in the galley but in the process of testing the smoke/heat detectors, another nonfunctioning detector was found. The heat detector in the engine room was not testing because some testing methods can actually damage the detector[26]. During the repair to the detector in the galley, it was found that the original wiring powering the detector was not working. The new detector was rewired using an existing cable that was found wired to that location but was not in use. According to the technician, each smoke detector was independently wired to the panel. He also indicated he did not see any type of end of line device.

This system is required to be tested yearly. In past inspections, the Coast Guard conducted the inspection of the detector and alarm panel themselves[27]. This involved testing the panel and using artificial smoke to test the smoke/heat detectors. According to the Port Captain for SunCruz, he could not recall the heat detector in the engine room being testing during his time with the company. For the most recent inspection, the Coast Guard did not inspect the system since it was being repaired when the inspectors were doing their inspection. The Port Captain assumed that the repair and testing report from the repair company was going to be accepted by the Coast Guard as a third-party inspection submission.

No smoke/heat or heat detectors were found in the debris. In addition, the alarm panel was not found in the debris. These components were assumed consumed by the fire.

The master on duty stated that he never heard any alarm nor saw any flashing lights on the alarm panel. Based on the location of the panel to the right of the wheel, he believed if it sounded, he would have heard or seen the alarm. Neither of the deckhands recalled hearing the alarm going off when in the pilothouse during the fire event.

[25] The term "open" was a direct statement from the Aqualarm representative. However, the original Aqualarm system used thermostats as initiating devices instead of heat/smoke detectors. Therefore, the system would have been an open circuit, closing the loop when the thermostat closed due to heat.

[26] Heat detectors use a set of temperature-sensitive resistors called thermistors that decrease in resistance as the temperature rises. The heat require to actuate a heat detector during testing can alter the sensitivity of the thermistors, affecting the performance of the detector.

[27] It is common practice for CG inspector to allow third-party inspection of fire suppression and detection systems. The third party must be a licensed to service the fire protection system being inspected. The CG inspector will usually attend these third party service-inspections.

DCA05MM002
Express Shuttle II Engine Room Fire

Fire Group Factual
Appendix A

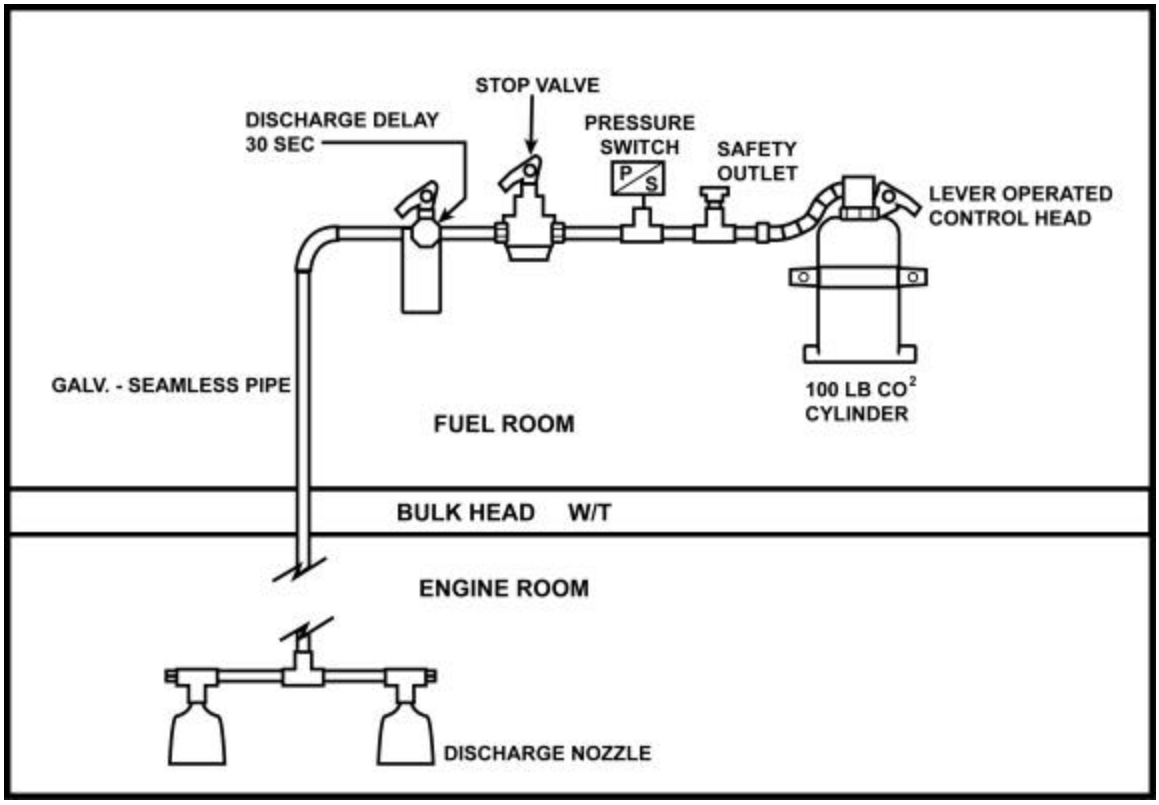

Figure 1A: Fire suppression system diagram.

Figure 1B: Photograph of fire suppression system actuators.

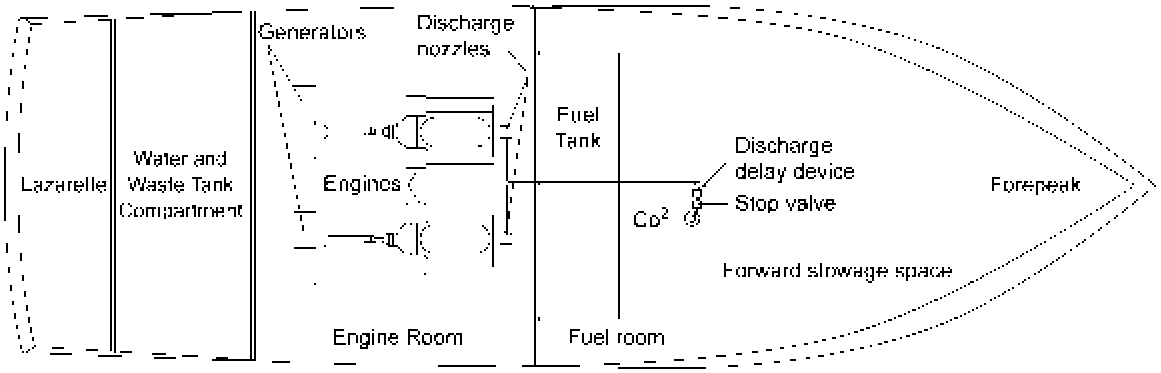

Figure 2A: Fire suppression layout diagram.

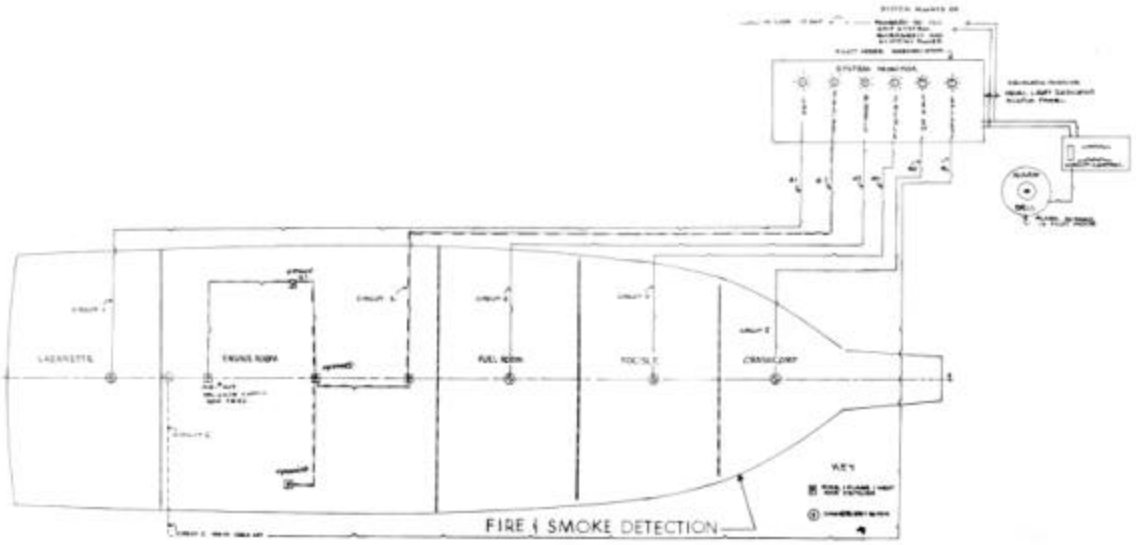

Figure 3A: Fire detection system layout diagram (as designed).