



**The Bahamas
Maritime Authority**

THE COMMONWEALTH OF THE BAHAMAS

M.v. SEADREAM I

IMO Number 8203438

Official Number 731014



**Report of the investigation into an engine room fire
on 01st September 2016 approximately 43nm off the
South West Italian coast.**

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Date of Issue: 07 July 2018
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1. GLOSSARY OF ABBREVIATIONS AND ACRONYMS

2/E	Second engineer
AE	Auxiliary engine
AER	Auxiliary engine room
AG	Auxiliary generator
ASI	Annual safety inspection
BA	Breathing apparatus
BMA	Bahamas Maritime Authority
CCTV	Closed-circuit television
C/E	Chief Engineer
CP	Controllable pitch
DOSC	Deputy on scene commander
DPA	Designated person ashore
ECR	Engine control room
EOOW	Engineer officer of the watch
ETA	Estimated Time of Arrival
FT	Fireteam
GES	General emergency station
HFO	Heavy fuel oil
IMO	International Maritime Organization
Knots	Nautical miles per hour
kW	Kilowatt
m	Metre
MCA	Maritime and Coastguard Agency
MRCC	Maritime rescue coordination center
MSC/Circ.	Maritime Safety Committee circular
NM	Nautical mile
OOW	Officer of the watch
OSC	On-scene commander
PA	Public address system
PMS	Planned maintenance system
PSC	Port State control
PSSC	Passenger ship safety certificate
RINA	Registro Italiano Navale
SCBA	Self-contained breathing apparatus
SOLAS	International Convention for the Safety of Life at Sea
STCW	International Convention for Standards of Training, Certification and Watchkeeping
UHF	Ultra High Frequency
UTC	Universal co-ordinated time
VDR	Voyage Data Recording
WTD	Watertight door

All times noted in the report are given in the style of the standard 24-hour clock without additional annotation and as local time UTC +2 hours. Fire alarm system computer was not connected to the vessel master clock system and was 4 hours 34 mins behind the local time.

2. SUMMARY

- 2.1 On 01 September 2016 at approximately 0150 hours, SEADREAM I was proceeding on one main engine at approximately 12 knots along the coast of Italy en-route to Amalfi when a fire occurred in the vessel's engine room.
- 2.2 The vessel's fire dampers were closed and the engineering staff initiated the fixed fire-fighting (Flexifog) system in the engine room after isolating the fuel source. This resulted in the main engine to shut down and the vessel was left drifting in safe water, about 43 nautical miles from the nearest land.
- 2.3 On the Chief Officer's instructions with agreement of the Master, the crew evacuated all the passengers to a safe area of the vessel. Shortly thereafter the Master sent a distress call to the Italian Coastguard who initiated a rescue operation.
- 2.4 At 0300 hours the fire was confirmed to be extinguished.
- 2.5 At 0450 hours the Italian Coastguard dispatched a tug to assist the SEADREAM I, giving an ETA of 6 to 7 hours. At 1040 hours Italian Port State Control and a RINA inspector arrived on the vessel.
- 2.6 On the afternoon of 01 September, two coastguard vessels arrived on scene and began evacuating the passengers to the passenger ferry, 'ISLA DI VULCANO'. In total, 105 passengers and 61 crew members were evacuated, leaving 30 crew members onboard.
- 2.7 The vessel was towed by the tug 'ANACAPRI' to the port of Naples, Italy, arriving late afternoon on 02 September 2016.
- 2.8 From the evidence collected post incident, the probable cause of the fire was due to the diesel oil leakage from the fuel inlet pipe to #2 fuel pump where the top securing bolt had worked loose and was found at the bottom of the hotbox. The fuel leakage from the fuel pump joint was ignited by a hot spot on the starboard main engine, however, the exact location of the ignition could not be established due to the significant damage in the area of the fire.
- 2.9 There were no deaths, injuries or pollution reported due to the incident.

3. DETAILS OF INVOLVED VESSEL(S) AND OTHER MATTERS

- 3.1 The SEADREAM 1 is a small passenger cruise vessel, constructed in the Wartsila, Helsinki shipyard in 1984. The vessel was originally named as SEA GODDESS I. The vessel has two main engines which provide propulsive power to two controllable pitch propellers via two fixed shafts. The vessel is certified to carry 116 passengers and 92 crew.
- 3.2 At the time of the incident, the vessel was carrying 105 passengers and 91 crew and was managed and operated by SeaDream Yacht Club AS.
- 3.3 The vessel was first registered with The Bahamas Maritime Authority (BMA) in June 1998 and was entered with Lloyds Register Classification Society in October 2004. At the time of this incident, the ship held all the necessary and required statutory certification.

3.4 Ship particulars

Ship Name:	SEADREAM I
Ship type:	Passenger/Cruise
LR/IMO No.	8203438
Call Sign:	C6PW8
MMSI No.	308908000
Flag State:	Bahamas
Port of Registry:	Nassau
Classification Society:	Lloyds Register
Owner:	SeaDream Yacht Club AS
Operator:	SeaDream Yacht Club Management
Year of Build:	1984
Shipbuilder:	Wartsila Ab - Helsinki
Length Overall:	104.830m
Length (BP):	90.560m
Breadth:	18.2 m
Draught:	4.001 m
Air Draft:	25.2 m
Gross Tonnage:	4,333 tonnes
Net Tonnage:	1,299 tonnes
Prime Mover Detail:	Wartsila Oy
Engine Builder:	Wartsila Ab - Finland
	2 x 12V22HF, 4 Stroke, Single Acting, Vee, 12 Cy. 220 x 240, Mcr: 1,770 kW (2,406 hp) at 1,000 rpm
Auxiliary Engines:	Wartsila Oy
Engine Builder:	Wartsila NSD

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3 x 4R22HF, 4 Stroke 4Cyl. 220 x 240, Mcr: 530 kW

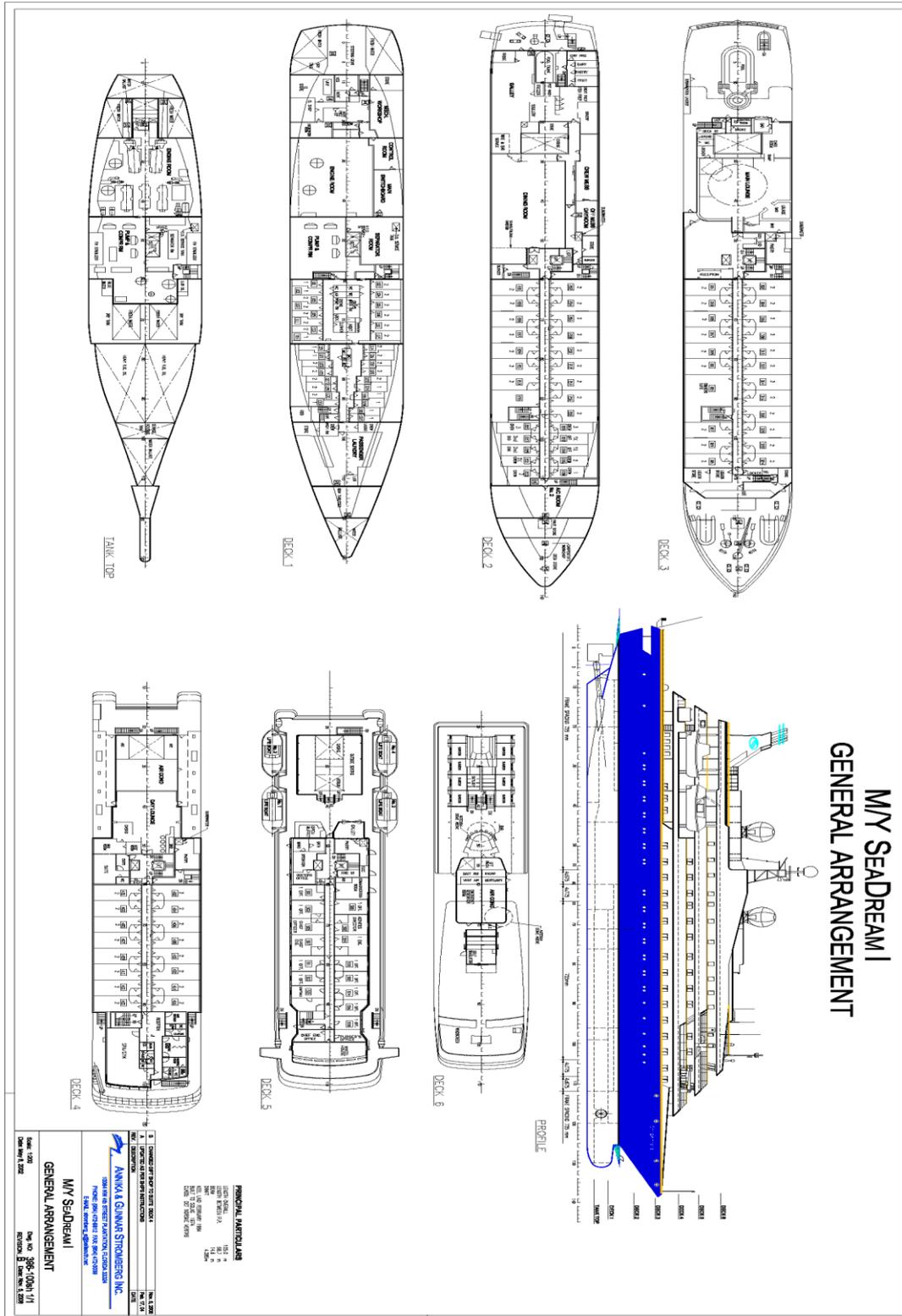


Figure 1: SEADREAM 1 General arrangement plan

3.5 Condition of Vessel (Class, Flag & Manager's Inspections)

- 3.5.1 The SEADREAM I fulfilled the required surveys mandated by International Conventions. The vessel had been issued with a Passenger Ship Safety Certificate that was valid until 30 March 2017.
- 3.5.2
- | | |
|---------------------------------|---|
| Continuous Hull Survey Due | 2019-03-30, Lloyd's Register |
| Continuous Machinery Survey Due | 2019-03-01, Lloyd's Register |
| Tail Shaft Survey Due | 2019-05-01, Lloyd's Register |
| Docking Survey Due | 2019-05-05, Assigned 2016-05-06, Lloyd's Register |
| Annual Survey Due | 2017-03-31, Lloyd's Register |
- 3.5.3 On the 25 June 2016, whilst in Piraeus, Greece, the vessel underwent its annual Flag State Inspection conducted by an approved Bahamas Maritime Authority Nautical Inspector. No deficiencies were reported during the inspection. However, there were two additional instructions from BMA Inspections and Surveys department for the Inspector to verify. Firstly, the quick closing valves were to be examined and tested and secondly, the local application water spray systems were to be inspected and verified that they are ready for use, with all the valves within the piping system in the correct position to allow immediate operation. It was reported that both additional items were verified during the inspection.
- 3.5.4 On the 14 August 2016, the vessel underwent a port State inspection; this inspection was conducted in the port of Dubrovnik. The following deficiencies were reported:
- i. Fire detection and alarm system not working as required. A smoke detector in the steering gear room and a heat detector in the ER workshop were replaced before departure.
 - ii. Missing symbol for emergency fire pump to add to the Fire Control and Safety plan. This had been rectified within the 14-day window as required.
- 3.5.5 The Company periodically inspected the vessel in accordance with Safety Management System procedures. The last physical inspection by a Technical Superintendent was carried out in August 2016.
- 3.5.6 At the time of the incident, the vessel had a complement of 91 crew members. The crew were multi-national and comprised Master, Chief Officer, 11 'deck' department, 12 'engine' department and 78 'hotel' department members.
- 3.5.7 A Safe Manning Document (SMD) was issued by the Commonwealth of the Bahamas on 4th December 2013; the vessel not only met the requirements of the SMD but was provided with excess personnel in all departments.

3.6 Key personnel

- 3.6.1 The Master, a Norwegian national, (69 years of age) held an Unlimited Master Mariner Certificate at the management level (II/2) required by the Standards of Training, Certification and Watchkeeping (STCW) issued in Norway and endorsed by the Commonwealth of the Bahamas on 08 June 2016 and was duly recognized in accordance with the provisions of Regulation I/10 of the STCW 1978 convention. He had sailed as Master on board the SEADREAM I since the company started on 1 September 2001. The Master had been onboard the SEADREAM I for 7 weeks prior to the accident.
- 3.6.2 The Chief Officer, a British national, (38 years of age) held an Unlimited Master Mariner Certificate at the management level (II/2) required by the Standards of Training, Certification and Watchkeeping (STCW) issued in the United Kingdom and endorsed from the Commonwealth of the Bahamas on 8th June 2016 in accordance with the provisions of Regulation I/10 of the STCW 1978 convention. The Chief Officer has spent approximately 3 ½ years in total on-board the SEADREAM I and its sister vessel, SEADREAM II and had been on-board for 2 months during this contract.
- 3.6.3 The Chief Engineer, a Polish national, (58 years of age) held a Chief Engineering Officer qualification at the management level (III/2) required by the Standards of Training, Certification and Watchkeeping (STCW), endorsed by the Commonwealth of the Bahamas on 22 May 2015 and duly recognized in accordance with the provisions of regulation I/10 of the STCW 1978 convention. He joined has sailed on the vessel since 1999 working for various owners and has worked for SEADREAM Yacht club since 1 September 2001. The Chief Engineer joined the vessel on 20 July 2016 for this current contract.
- 3.6.4 The 1st Officer (safety), a Filipino national, (40 years of age) held the Chief Mate qualification at the management level (I/2) as required by the Standards of Training, Certification and Watchkeeping (STCW) certificate, issued by the Republic of the Philippines, endorsed by the Commonwealth of the Bahamas on 18 June 2016 in accordance with the provisions of Regulation I/10 of the STCW 1978 convention.
- 3.6.5 The 1st Officer (Navigation), a Filipino national, (43 years of age) held the Chief Mate qualification at the management level (I/2) as required by the Standards of Training, Certification and Watchkeeping (STCW) certificate, issued by the Republic of the Philippines, endorsed by the Commonwealth of The Bahamas on 13 April 2016 in accordance with the provisions of Regulation I/10 of the STCW 1978 convention. He has been at sea for 21 years serving with other cruise companies and has spent a total of 5 months on the SEADREAM I.
- 3.6.6 The Second Engineer, a Filipino national, (41 years of age) held the officer in charge of an engineering watch qualification at the operational level (III/1) as required by the Standards of Training, Certification and Watchkeeping (STCW) certificate, issued by the Republic of the Philippines, endorsed by the Commonwealth of the Bahamas on 05 May 2016 in accordance with the

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provisions of Regulation I/10 of the STCW 1978 convention. He has been at sea for 20 years and has spent a total of 3 years on the SEADREAM I, with 5 months during his present contract.

4. NARRATIVE OF EVENTS

- 4.1 On 1 September 2016, the SEADREAM 1 departed from the port of Taormina and was heading towards the port of Amalfi, Italy when the incident occurred.
- 4.2 The vessel was proceeding at a speed of 12.2 knots using the starboard main engine, having stopped the port main engine just after midnight due to the vessel's ability to maintain the required speed on just the single engine. The vessel's electrical power was supplied by two of the three auxiliary diesel engines.
- 4.3 The engine-room was manned by the Second Engineer and Motorman for the 1200 – 0400 watch. The bridge was manned by the 1st Officer (Safety) and an Able-Bodied seaman on lookout duties.
- 4.4 At approximately 0150 hours the Second Engineer received the main engine booster pump low-pressure alarm on the engine monitoring system followed quickly by the main engine starboard fuel oil low-pressure alarm. Figure 2 shows the alarm sequence from the initial main engines FO (Fuel Oil) booster low-pressure alarm at 00:30:42¹ (local indication on engine monitoring system) followed by; ME starboard FO low-pressure some 6 seconds later at 00:30:48.

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ALM-> 16/09/01 00:30:42 PIAL 10.401  MAIN ENGINES FO BOOSTER PRESS  0.98 BAR
ALM-> 16/09/01 00:30:48 PIAL 01.501  ME STBD FUEL OIL PRESS      2.0 BAR
ALM-> 16/09/01 00:32:38 TIAL 04.421  AUX ENG 1 LO TEMP LOW LOAD    59 Deg.C
ALM-> 16/09/01 00:32:59 01.951  ME STBD FO BOOSTER PUMP FAIL

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ALM-> 16/09/01 00:32:38 TIAL 04.421  AUX ENG 1 LO TEMP LOW LOAD    59 Deg.C
ALM-> 16/09/01 00:32:59 01.951  ME STBD FO BOOSTER PUMP FAIL
ALM-> 16/09/01 00:35:32 09.401  FIRE ALARM
ALM-> 16/09/01 00:35:40 PIAL 01.531  ME STBD FW COOL PRESS LT     1.79 BAR
ALM-> 16/09/01 00:35:43 01.801  ME STBD OIL MIST DENSITY
ALM-> 16/09/01 00:35:43 02.411  GEAR STBD AUTOSTOP CLUTCH
3M-> 16/09/01 00:35:51 PIAL 02.201  GEAR STBD CLUTCH CONT. OIL PR.  14 BAR
ALM-> 16/09/01 00:36:03 TIAH 01.014  ME STBD FRAME BEARING NO. 2   164 Deg.C
EIALM-> 16/09/01 00:36:10 TIAL 04.441  AUX ENG 1 FW COOLING LOW LOAD  59 Deg.C
ALM-> 16/09/01 00:36:11 TIAH 06.521  SWIMMING POOL TEMPERATURE     38 Deg.C
OK-> 16/09/01 00:36:14 10.941  MAIN ENGINES FO BOOST PMP FAIL
    
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Figure 2: Engine room alarm list

¹ Subsequent investigation showed that there was an error of 1 hour 20 minutes between local indication on engine monitoring system and ship's time.

- 4.5 At 0200 hours the vessel's position² was reported to be 39° 19.3N 015° 00.4E, approximately 43 nautical miles to the west of Naples and stopped in the water and classified as Not Under Command³ by the Collision Regulations.

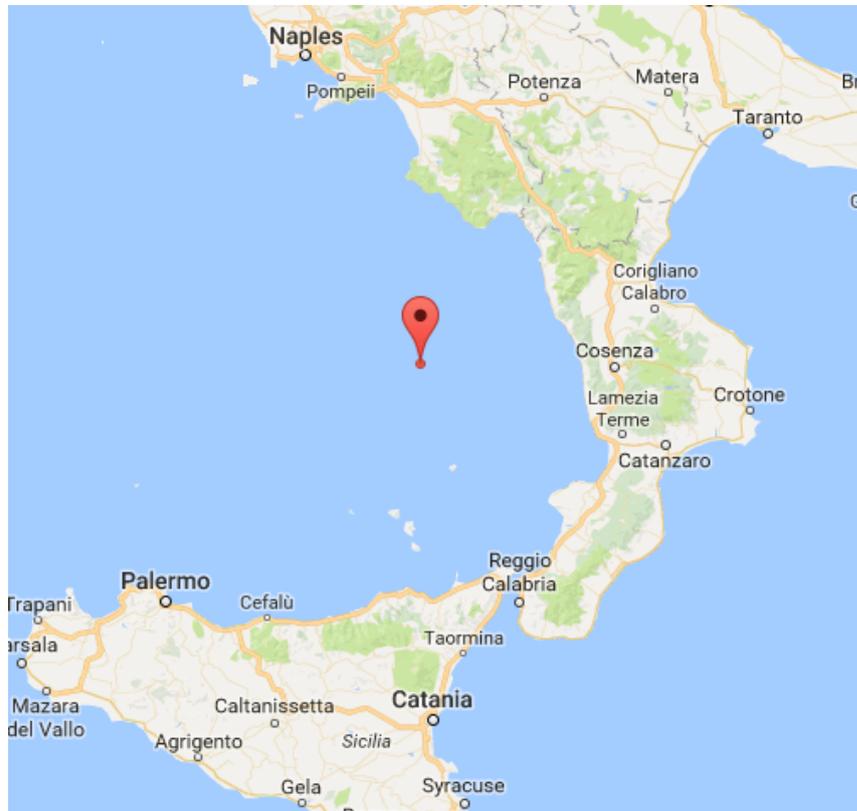


Figure 3: Position of SEADREAM I at 0200 hours on 1 September 2016

- 4.6 The Second Engineer (2/E) checked the running light of the booster pump and confirmed that it was still running. The 2/E immediately called the Motorman and asked him to investigate the problem, at which point the Motorman reported back that there was a large fuel leak on the aft end of the inboard cylinder bank of the starboard main engine.
- 4.7 The 2/E immediately went to the apparatus room to stop the fuel booster pump and on re-entering the ECR observed a lot of smoke inside. The 2/E also observed smoke and fire on the CCTV system located in the ECR in way of the starboard main engine. The booster pump was subsequently shut down at 00:32:59.
- 4.8 According to the alarm readout (figure 2) the ER fire alarm was activated at 00:35:32 and the second engineer reported the fire to the bridge, at which point he informed the Officer of the Watch, that he was taking control of the main engine and immediately stopped it using the emergency stop, this was

²GPS reading taken from the deck log book (Annex 1)

³The COLREGs state in Rule 3(f): The term “vessel not under command” means a vessel which through some exceptional circumstance is unable to manoeuvre as required by these Rules and is therefore unable to keep out of the way of another vessel.

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logged locally at 00:35:43. The Second Engineer then called the Chief Engineer and reported the fire.

- 4.9 The Master was called in the meantime and he attended the bridge and took over the watch from the 1st Officer. The Master was assisted on the bridge by the Communications Officer, Chief Purser and Assistant Purser.
- 4.10 The Master attempted to operate the fire alarm, but it was found to be inoperable, he also attempted using the Public Address system but again this was found to be inoperable. Both of these systems had been successfully tested on 27 August 2016 and 29 August 2016 respectively. The Chief Officer woke up the crew and the Master dispatched the First Officer, who along with the night Steward and night Stewardess woke up the passengers.
- 4.11 Before evacuating the engine room, the 2/E pressed the fixed sprinkler system activation button, located in the engine control room for the starboard main engine.
- 4.12 Within seconds of the Motorman reporting the fuel leak to the 2/E the fuel ignited in the vicinity of the leakage. Immediately, the Motorman grabbed the transportable dry powder extinguisher at the forward end of the starboard engine and attempted to extinguish the fire. The Motorman soon realized that his actions were ineffective due to the amount of smoke and heat generated from the fire.

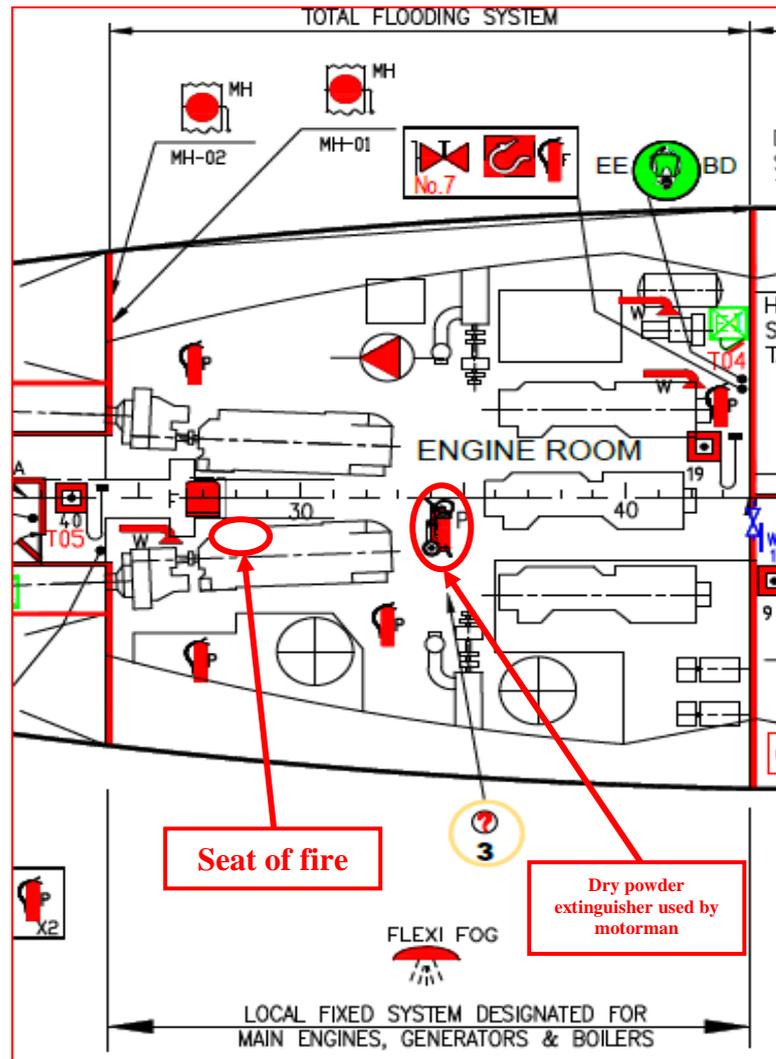


Figure 4: Layout of the engine room on tank top showing dry powder extinguisher forward of main engines

- 4.13 The Motorman proceeded to exit the engine compartment through the C1 watertight door, crucially stopping to close the door behind him preventing the fire spreading to adjacent compartments. The Motorman then exited the engine room and proceeded to the aft deck emergency station where he met with the 2/E, who by this time had also exited the engine room.
- 4.14 The engine room fire team assembled on the aft deck and both Second Engineers donned the fire suits and breathing apparatus.
- 4.15 The Master gave the order to send a mayday message at 0210 hours and this was acknowledged by Palermo coastguard at 0229 hours. The vessel was informed at 0240 hours that tug assistance was en-route.
- 4.16 After the Chief Engineer was called he proceeded to the 'safety center' (figure 10) on deck 3 where he activated all the remote pump stops and ventilation stops (figure 7), all dampers (figures 8 & 9) and quick closing valves (figure 5). Due to lack of air in the engine room control air system, it was necessary to

use the emergency air reservoir (figure 6) in the safety center in order to release the quick closing valves. The Chief Engineer then proceeded to the aft emergency station where he found the Engineers already donning the fire suits.



Figure 5: FO Quick closing panel in safety center



Figure 6: Emergency air reservoir and controls for Quick Closing Valves



Figure 7: Fuel tank quick closing valves in fuel oil room



Figure 8: Emergency stops for pumps, boilers and ventilation



Figure 9: Control box for fire dampers



Figure 10: Damper controls

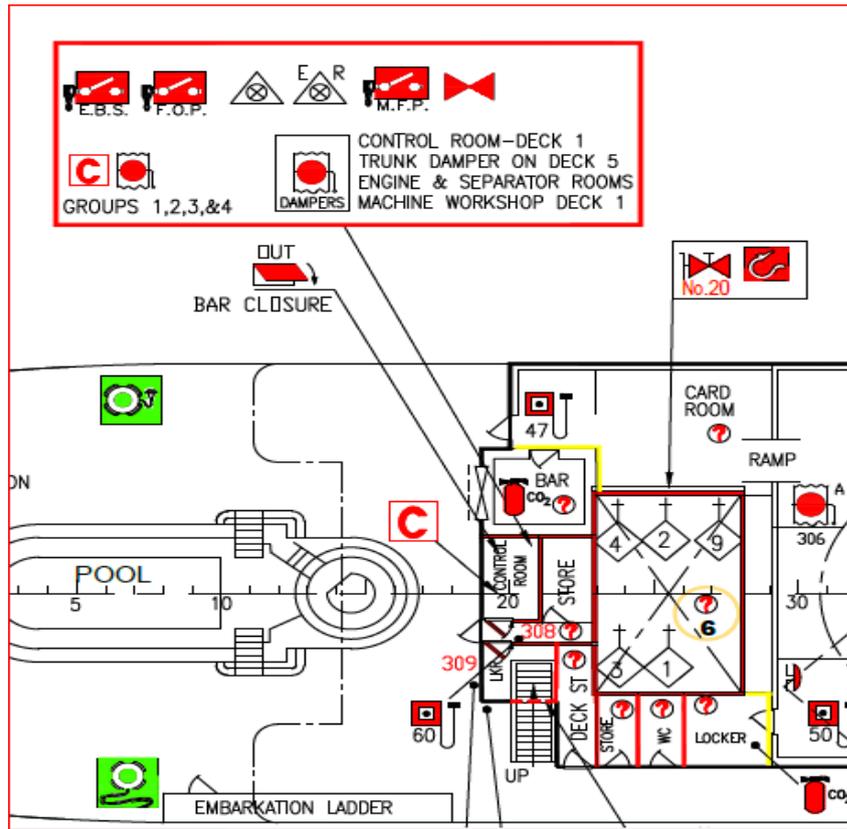


Figure 11: Control Room location Deck 3

- 4.17 The 2-person fire team proceeded to the main engine room door aft and assessed the temperature of the door. They assessed that the temperature of the door was too hot and retreated back to the fire station. The Chief Engineer then ordered them to be on standby and instructed them not to enter the engine room without his permission.
- 4.18 The Chief Engineer donned a BA set and proceeded to the ECR to check if the sprinkler system (figure 11) had been activated. He observed that although the power supply indication was on, there was no power to the screen showing the zones.



Figure 12: Flexifog system in ECR

- 4.19 During this period the Chief Officer began to set up boundary cooling of the engine room compartment in the area of deck 4, 5 and 6 around the engine casing, utilizing fire team #2.
- 4.20 Due to the amount of heat and smoke still being generated, the Chief Engineer suspected that there was something wrong with the sprinkler system in the engine room. The Chief Engineer proceeded to the pump room, which is the next compartment to the engine room compartment on fire.

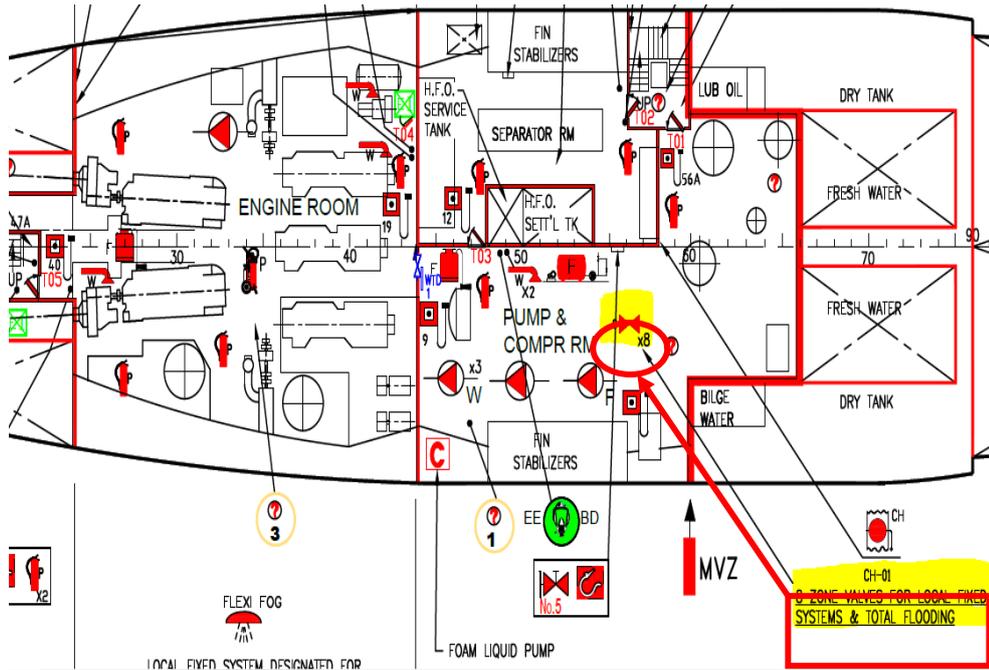


Figure 13: Position of sprinkler system valves in pump room on the tank top

4.21 On reaching the pump room the Chief Engineer found that all 4 sprinkler system supply pumps (figure 13) were running and the manifold pressure was at a pressure of between 17 – 19 bars, however, the manifolds for the release zones were showing a zero-bar pressure. The lack of pressure on the zone manifolds indicated that none of the sprinklers for the zones had been activated.



Figure 14: Water mist supply pumps in the pump room

4.22 On realising that there was currently no extinguishing median entering the spaces on fire, the Chief Engineer manually operated the release solenoid

valves (figure14) for the main engine 1, main engine 2, boilers and generators. One of the solenoid valves was not staying in the open position, so the Chief Engineer kept it open with the assistance of a G-clamp (figure15).

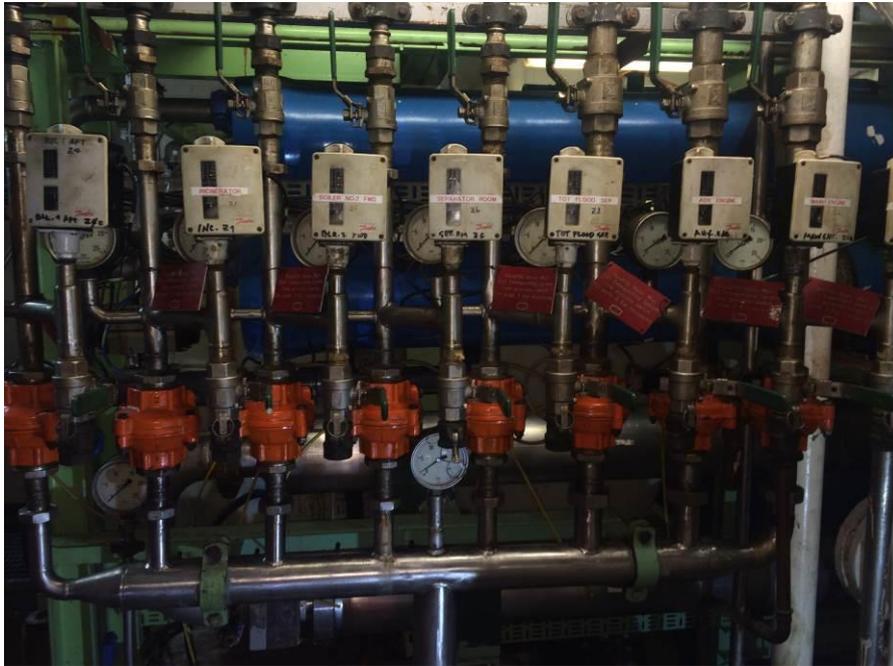


Figure 15: Water mist release solenoids in the pump room

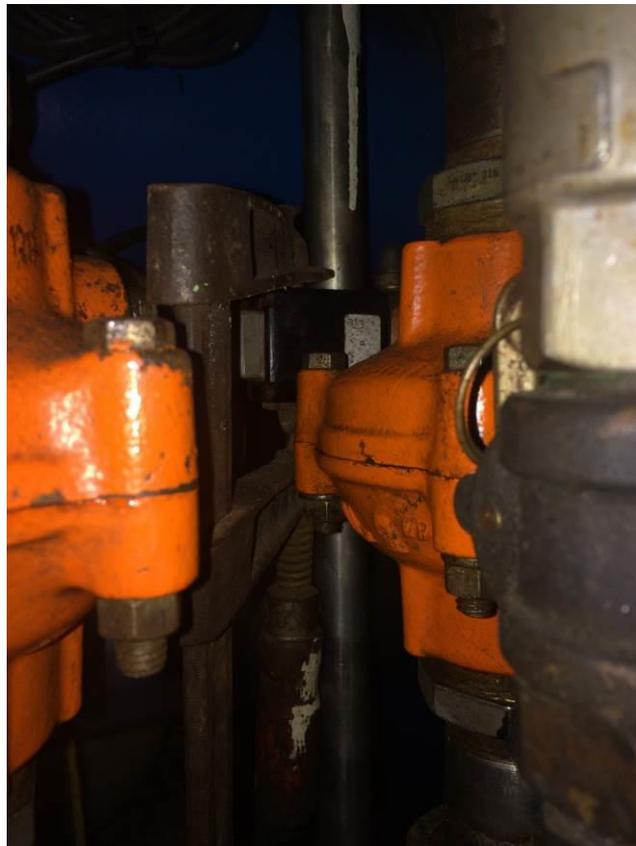


Figure 16: G-clamp holding open solenoid release valve

- 4.23 After a period of approximately 10 – 15 minutes the Chief Engineer (C/E) stopped the sprinkler pumps to check the temperature of the bulkheads and doors without entering the engine room He decided to start the pumps again to continue operation of the sprinklers.
- 4.24 During this period when the C/E was operating the sprinkler system the emergency generator failed due to a high temperature of the generator cooling water. This shutdown was caused by the loss of engine room control air when the fire dampers on the emergency generator compartment were activated. These dampers are designed to close on the failure of air pressure, but this had the secondary effect of cutting off the cooling air supply to the generator air cooled radiator.

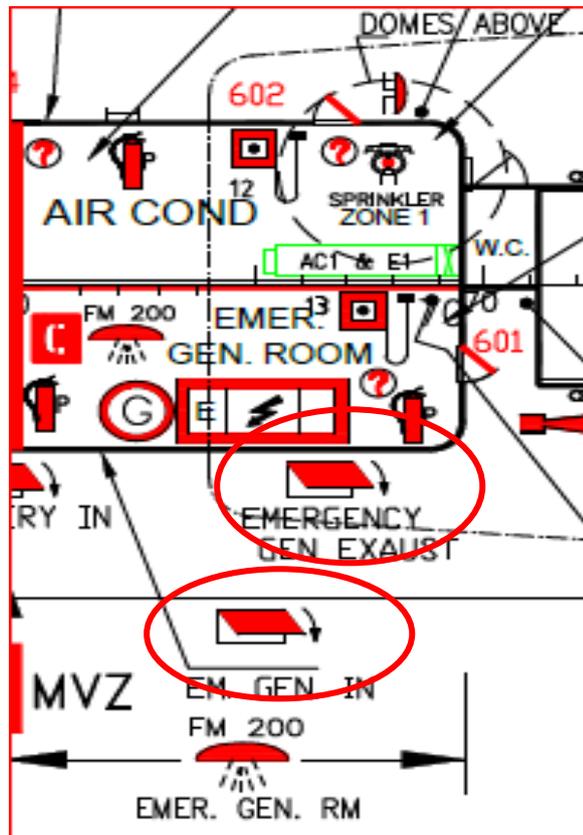


Figure 17: Emergency generator room air inlet and exhaust

- 4.25 The Chief Engineer instructed the electrician to open the dampers manually and this had to be done by disconnecting the damper mechanism from the air actuated cylinder (figure 18). The Chief Engineer also instructed the Electrician to override the High-Temperature shutdown, which allowed the generator to be restarted immediately. The generator was then put back online after approximately 15 minutes.



Figure 18: Air-actuated damper control for emergency generator

- 4.26 Due to the emergency generator stopping, the sprinkler pumps had cut out and the Chief Engineer had to go back to the pump room and restart (figure 19) them in order to continue the fire-fighting efforts.
- 4.27 The pumps continued running for approximately 10 more minutes until the Chief Engineer observed a reduction in temperature on the surrounding bulkheads.



Figure 19: Sprinkler pump starters in the pump room

- 4.28 After another 10 minutes, the C/E decided that it was safe to re-enter the engine room and on doing this he observed that the fire was extinguished. This was then reported to the bridge at 0300 hours.
- 4.29 The boundary cooling team (fire team 2) were still cooling the bulkheads on decks 4, 5 and 6 at this point due to the residual heat build-up in the surrounding area.
- 4.30 The passengers at this point had been moved from the muster stations to deck 6 (forward) due to the presence of smoke generated by the fire. The Chief Officer checked on all the passengers and made sure that the muster was complete.
- 4.31 Palermo coastguard advised the SEADREAM 1 that three merchant vessels had been dispatched to render assistance. These vessels, M/V EUROCARGO NAPOLI, M/V LUKA S and M/Y OMEGA arrived on site at approximately 0400 hours and stood by waiting for further instruction from the coastguard.
- 4.32 The vessel remained without propulsion as the starboard main engine was badly damaged and the main propulsion and alarm system was disabled which prevented the use of the starboard main engine. The auxiliary generators were also disabled and the vessel remained on power supplied by the emergency generator.
- 4.33 At 1540 hours two coast guard vessels transferred 105 passengers and 61 crew members to the fast craft “ISLA DI VULCANO”, which took them to Naples.
- 4.34 At 1925 hours the tug “ANACAPRI” arrived to tow the SEADREAM 1 back to Naples.

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- 4.35 On 2 September 2016 at 1700 hours the vessel arrived under tow alongside Naples cruise terminal.

5. ANALYSIS AND DISCUSSION

5.1 Aim

5.1.1 The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

5.2 Weather conditions

5.2.1 The environmental conditions before the incident (at 0100 hours) were reported as sea state 3 with a Beaufort⁴ wind force 5 from a north-easterly direction. The vessel was steering a course of 350° true with the wind fine on the vessel's port bow.

5.3 Location and cause of the fire

5.3.1 On initial investigation of the incident, it was observed that the seat of the fire was around the aft area of the Starboard main engine, on the engine room tank top level.

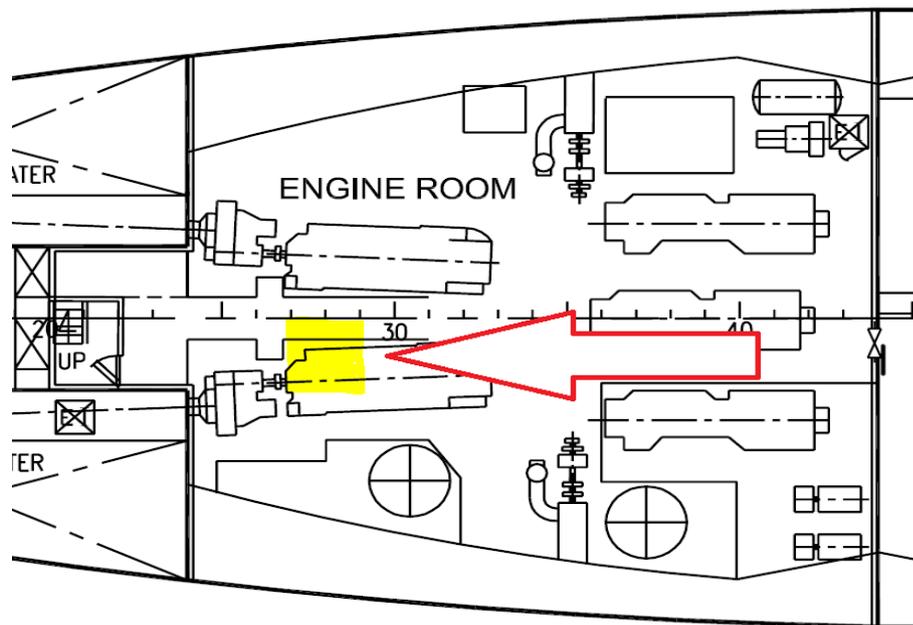


Figure 20: Location of the fire

5.3.2 On closer examination of the scene of the fire, it was evident that the heat source was based at the aft end of the starboard main engine in way of #2 cylinder of the A-bank⁵ (figure 21).

⁴ The Beaufort scale of wind force, developed in 1805 by Admiral Sir Francis Beaufort, enables sailors to estimate wind speeds through visual observations of sea states.

⁵ V type engines have 2 banks of cylinder sets classified as A bank and B bank located on either side of the engine.



Figure 21: Starboard main engine A-bank Cylinders 1 & 2

- 5.3.3 The hot box covers (covers enclosing the fuel pumps and fuel pipes) were removed from the inboard bank of cylinders of the starboard main engine and it was immediately evident that the top bolt was missing from #2 fuel pump fuel inlet pipe (figure 22).



Figure 22: Top bolt missing from fuel inlet pipe

- 5.3.4 The missing bolt was found in the bottom of the hotbox, under the pipe. The bolt had not sheared and it appeared that the bolt had worked free by itself.

The bolt was not damaged and a washer was still present by the bolt head (figure 24.)

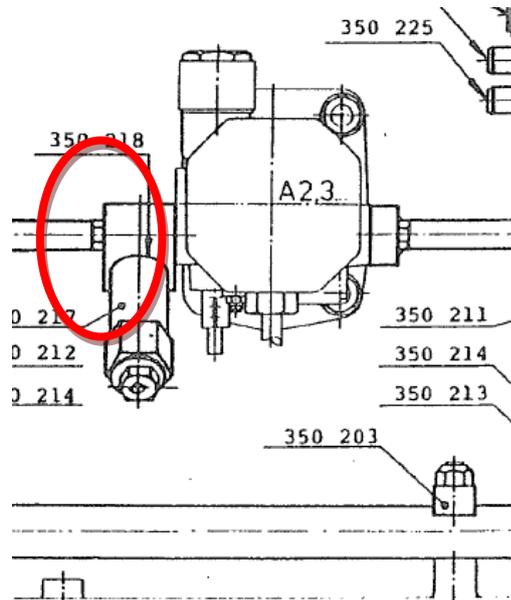


Figure 23: Fuel oil inlet pipe to the fuel pump



Figure 24: Bolt from fuel inlet pipe

- 5.3.5 It is likely that the bolt tension was last checked when the fuel pump was last replaced, as there was no requirement within the planned maintenance system to check the pump up until the incident took place. It is highly probable that the bolt worked its way loose due to the vibration of the engine which may have been a result of the bolt incorrectly torqued in the first instance.
- 5.3.6 The fuel pump had been changed by the ship's crew as per planned maintenance scheme on 17 April 2015 (figure 25).

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601.26.08 FUEL INJECTION PUMP - No A2 - ME / SB								
4/17/2015	1	6	Checked F.O. Pump	101,063	HA	EN	A	Flode Idorot
9/3/2014	1	5	Check pump	99,456	HA	EN	A	2nd Engr. Lambert Laza
1/20/2012	1	4	Check fuel pump	91,275	HA	EN	A	2nd Engr. Lambert Laza
4/17/2015	2	5	Changed F.O. Pump	101,063	HA	EN	A	Flode Idorot
9/3/2014	2	4	Change pump	99,456	HA	EN	A	2nd Engr. Lambert Laza
1/20/2012	2	3	Change fuel pump	91,275	HA	EN	A	2nd Engr. Lambert Laza

Figure 25: Printout from planned maintenance system

5.3.7 The Motorman's report to the Second Engineer was that there was fuel pouring out of the area of the starboard main engine where the fuel pipe bolt was missing. Shortly afterward, the motorman also reported that ignition of the fuel took place as it came in contact with a hot surface in the vicinity of the starboard engine. This appears to be consistent with the main area of fire damage and was verified by the Second Engineer's observation on the engine room CCTV system⁶.

5.4 Damage to the main engine and compartment.

5.4.1 The fire engulfed the aft area of the starboard main engine, damaging both main engines; power and control of instrumentation cables; both boilers and their ancillaries; all three auxiliary diesel engines; alarm systems; structural steelwork; fixtures and fittings all the way to the top of the funnel casing.



Figure 26: Gearbox instrumentation panel

⁶ CCTV system was a live system onboard with no data recording facility



Figure 27: Control cabling junction boxes



Figure 28: Damage above Starboard main engine



Figure 29: Heat and smoke damage to Portside funnel

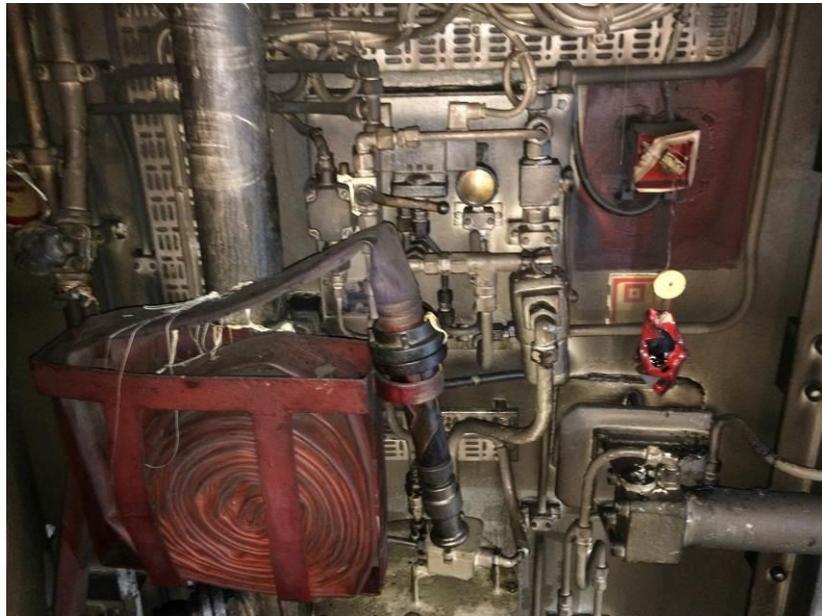


Figure 30: Heat and smoke damage to the engine room forward bulkhead



Figure 31: Fire damage to the aft section of starboard main engine



Figure 32: Damage to the area in way of starboard gearbox and oil cooler



Figure 33: Starboard main engine pressure switches



Figure 34: Local alarm column on forward ER bulkhead



Figure 35: Starboard main engine control cabling

5.5 System Failures

- 5.5.1 The fire alarm was activated in the engine room and this was repeated on the bridge. The First Officer (Safety) acknowledged the fire alarm and then reported that the fire alarm system was giving multiple alarms and printing the log continuously. The Master attempted to activate the general fire alarm but discovered it was inoperable and the panel appeared to be malfunctioning.
- 5.5.2 On Failure of the general alarm signal, the Master then attempted to make an announcement on the public address System (PA System), but this was also inoperable. As the vessel had no ability to inform the passengers that there was a fire through audible means, it was required to send crew members to the passenger and crew decks to verbally inform the cabin occupants that there was a fire and they were to evacuate the accommodation and proceed to their nominated muster stations.
- 5.5.3 The general alarm and public address system was last successfully tested on 29 August 2016 with no indication that it would not operate 3 days later.
- 5.5.4 The watch keeping Second Engineer released the Flexifog system in the main engine room from the control panel in the ECR and evacuated the area due to the amount of smoke occupying the space. He did not have the time to verify that the system was operational. It was later confirmed by the Chief Engineer that the system had not activated and required the manual intervention from the Chief Engineer to open the solenoid valves from the common manifold to the zone manifolds.

- 5.5.5 The loss of compressed air resulted in the emergency generator room fire dampers to close, due to the 'Close on failure'⁷ system. This had the secondary effect of overheating the generator, in turn shutting it down on high temperature alarm. The Chief Engineer had to instruct the Electrician to physically disconnect the pneumatic closing mechanism and manually open the fire dampers. The Chief Engineer then had to instruct the Electrician to override the high-temperature shutdown, which allowed the generator to be restarted and cool down.
- 5.5.6 During the time when the emergency generator was offline, the only power to the vessel was via the emergency batteries, powering the communication equipment and emergency lighting.
- 5.5.7 The failure of the escape hatch to close in the funnel case at deck 5, contributed to the spread of the fire resulting in extensive damage in the funnel casing (figure 29).
- 5.5.8 A review of the logs maintained by the vessel indicates a difference in timings between the bridge logbook and the time stamp of various electronic logs. The difference between the timings appears to be because the electronic systems had not been linked to the vessel's master clock system and therefore were out of synchronisation.

5.6 Fire detection system alarm manufacturers investigations

- 5.6.1 On 09 September 2016, a service engineer from the fire alarm system manufacturer attended the vessel in Naples to investigate the system faults. The service engineer issued a report⁸ on 05 October 2016 with a number of findings. Firstly, it was noted that the fire alarm system computer was not connected to the vessel master clock system and was 4 hours 34 mins behind the local time. It can be assumed that this was the same during the incident.
- 5.6.2 According to the system history log downloaded by the service Engineer, the first alarm activated was detector A0122, positioned above the starboard main engine, located in main engine room DK-1 Z-ENG at the date and time of 31.08.2016, 21:17⁹, this equated to 01:51 hours ship time.
- 5.6.3 The second detector A0120, located above the port main engine, was activated at 01:52 hours (ship time) closely followed by detector A0279 in the funnel at deck 2 and detector A0119 in the main engine room. This confirms that the fire started in the region of the starboard main engine and spread quickly into the funnel casing.

⁷ The damper in emergency generator room were designed to close on failure of air pressure. This had a secondary effect of cutting of the cooling air supply to the generator air cooled radiator, leading to overheating of the generator and subsequently shutting down due to high temperature alarm.

⁸ Autronica report 20160928_Fire report_Seadream 1, dated 2016-10-05.

⁹ Fire alarm system computer was not connected to the vessel master clock system and was 4 hours 34 mins behind the local time

- 5.6.4 The smoke had spread outside the engine room areas after 3 minutes when the detector A025 (galley vent at deck 2) and the detector A0209 (corridor port aft at deck 2) were activated.
- 5.6.5 The alarm log¹⁰ shows that 37 detectors gave an alarm in the first 10 minutes of the fire and this shows the extent of the spread of the smoke throughout the vessel.
- 5.6.6 The first system fault was recorded at 01:53 hours (ship time) on the BS-100 panel closely followed by a short circuit alarm on loop 1. The service Engineer's report states that this indicates that the loop cable had melted due to the heat in the engine room.
- 5.6.7 Although the BS-100 central computer and Autromaster 5000 graphical computer on the bridge were still operational, the 220V fuse supplying the fire cabinet had tripped due to the short circuit on the fire alarm bells cables. The tripped fuse prevented the general fire alarm bells from operating.

5.7 PA/GA system manufacturers investigation

- 5.7.1 On 12 September 2016, a service Engineer attended the vessel in Naples in order to investigate the fault in the public address (PA) and the general alarm (GA) systems.
- 5.7.2 The service Engineer issued a report¹¹ on 14 September 2016 with a number of findings. During the inspection, the SM-30 PA/GA unit defaulted to its factory settings without authorisation. The service Engineer stated that this should not happen under any circumstance. When the unit was reprogrammed, the fault was not replicated.
- 5.7.3 The system amplifier unit was inspected and tested, no functional defects were observed.
- 5.7.4 During the inspection and testing of the loudspeaker network, several faults were observed. A number of the faults were caused by earthing of the existing cabling and several were due to the fire damage.
- 5.7.5 After the inspection of the speaker system the Engineer completed a function test of the PA/GA system with the following results:
- A complete test of the Public Address (PA) system was found to be successful.
 - Complete test of the General Alarm (GA) system was unsuccessful.
- 5.7.6 Fault finding of the GA system discovered that some of the power loops to the alarm bells in the area of the fire were damaged due to heat, causing a fuse in the bridge junction box to trip due to a short circuit. This fuse was for the AC

¹⁰ Alarm log printout from vessel

¹¹ Hans Backens Elektronik GmbH report dated 14.09.16

power supply to the fire detection system, which included the PA/GA programmable control unit, rendering the system inoperable; hence the inability to hear the PA system when the Master attempted to make an announcement and the non-functioning of the general fire alarm bells.

- 5.7.7 After the faulty cables were disconnected and the AC supply fuse was reset, the functionality of the remaining system returned and subsequently demonstrated to the Lloyds Register surveyor.

5.8 Flexifog system manufacturers investigation

5.8.1 The fixed application system fitted on board is a Flexi-Fog Fire Extinguishing System manufactured by Heien-Larssen and is approved by Lloyds Register of Shipping. The system was inspected by service agents Autronica Fire and Security AS in July 2016 and found to be functioning satisfactorily. The manual spray system provides a network of nozzles throughout the engine room, covering the areas of the main engines, boilers and auxiliary engines. The nozzle houses a deflector plate causing water to spray out over a large area. The water is supplied initially from a tank pressurised by compressed nitrogen, once the tank pressure falls, as a nozzle issues water, a salt water pump cuts in automatically to maintain the water supply as long as is necessary.

5.8.2 On 08 September 2016, two service Engineers from the FlexiFog manufacturer attended the vessel in Naples to investigate the system faults.

5.8.3 The service Engineers issued a report¹² on 04 November 2016 which had a number of findings:

- The system Profibus interface cables and nodes in the engine room were burnt and ceased to function very early in the evolution of the fire.
- The loss of the nodes caused a short circuit and a loss of the 24V DC supply.
- The loss of the 24V DC system prevented the remote operation of the High-Risk Zone Release.
- The loss of the 24V DC system prevented the activation of the foam system. As the foam valve is activated from the same 24 VDC supply as the zone valves and was not activated due to loss of power when the Profibus Interface cables short-circuited by the fire. This valve had no manual override.
- One nozzle (figure 36) was missing in the Main Engine High-Risk nozzle grid.

¹² Autronica report dated 04.11.16



Figure 36: Showing missing nozzle in the high-risk zone.

- 5.8.4 The missing nozzle from High-Risk zone of the FlexiFog system would have also contributed towards the reduction in the effectiveness of the system and this would have led to a delay in extinguishing the fire and hence potentially resulting in more damage. It is unknown as to when the nozzle disappeared from the pipeline and there was no evidence of it in the immediate vicinity. It is likely that the missing nozzle would have resulted in a reduced pressure in the system subsequently reducing the atomising ability of the other nozzles in the system.
- 5.8.5 Due to the inability to operate the system remotely, it was necessary to operate it manually from the local control station in the pump room. The failure of the FlexiFog remote activation and the subsequent manual activation of the system would have contributed to a delay in the firefighting efforts.
- 5.8.6 The routing of the FlexiFog control cabling and the subsequent fire damage to it resulted in the loss of the automatic activation capability of the system.
- 5.8.7 According to the vessel records, the FlexiFog system was serviced and tested in July 2016 and found to be satisfactory.
- 5.8.8 The manufacturers recommended the following measures:
- All system equipment in the engine room to be renewed.
 - Installation of an automatic release of the High-Risk zone from the fire alarm system.
 - Instruction of vessel's crew in the criticality rapid activation of the local water mist system.

- Consider a different cable routing outside of the engine room to prevent damage during a fire.
- Add battery back-up on the 24V system to maintain power to the control cabinet and panels for control of remote valves and pumps.

5.9 Fire damper hatch in funnel space (DK6 port side) failed to close properly

- 5.9.1 On inspection of the funnel space, it was noted that the escape hatch leading from the lower levels to deck 6 was not properly closed. This escape hatch would normally have the closing mechanism to be actuated as part of the damper system closing procedure in case of a fire in the space below.
- 5.9.2 The pulley system for the opening/closing of the hatch appeared to have a frayed wire (figure 37) that was fouling, preventing the hatch from fully closing. There was no mechanism to check this equipment in the vessel's planned maintenance system and the operation relied on the weekly testing rather a combined condition check and test.



Figure 37: Frayed wire on hatch closing mechanism

- 5.9.3 The damage in the funnel area showed a clear path of the heat from the engine fire and this heat was evident as far as the top of the funnel (figure 29) showing that the fire damper in way of deck 5 funnel space was ineffectual.
- 5.9.4 The inability to close the fire damper on deck 5 of the funnel space hampered the ability to extinguish the fire quickly and aided the spread of heat damage up the funnel space. There was no indication that the hatch was not closed

therefore no action was taken to mitigate the failure. Had the fire damper been closed, the damage in the funnel space could have been significantly reduced.

5.10 Fatigue

5.10.1 The vessel presented the records of hours of rest to the investigator and these confirmed that all crew members were in compliance with the statutory hours of rest requirements.¹³

5.11 Substance abuse

5.11.1 Alcohol test¹⁴ was carried out following the incident, there is no evidence to suggest that any sort of substance abuse was a contributory factor to the incident.

¹³ Required by the International Convention of Standards of Training, Certification and Watchkeeping for Seafarers, 1978 as amended (STCW) and the Maritime Labour Convention, 2006 (MLC 2006)

¹⁴ Alcohol test report dated 1 September 2016

6. CONCLUSIONS

- 6.1 On 01 September 2016 at 0150 hours the fire broke out in the vicinity of the aft inboard cylinder bank of the starboard main engine. From the evidence collected post incident, the probable fuel source for the fire was the diesel oil leakage from the fuel inlet pipe to #2 fuel pump where the top securing bolt had fallen out. It is unknown as to why the fuel line securing bolt fell out of the fuel pump, but it probably worked itself loose caused by vibration due to insufficient torque securing the bolt.
- 6.2 The fuel leakage from the fuel pump joint was ignited by a hot spot on the starboard main engine, however, the exact location of the ignition could not be established due to the significant damage in the area of the fire.
- 6.3 On discovery of the fire in the engine room, the watch-keeping Engineer cut off the fuel source to the main engine by shutting down the fuel feed pump to the main engine and at the same time the Motorman attempted to fight the fire with a portable extinguisher before exiting the engine-room.
- 6.4 The Motorman closed the watertight door between the main engine room and the pump room, which prevented the further spreading of the fire to other compartments. There were minor damages observed to the adjacent compartments.
- 6.5 The public address (PA) and the general alarm (GA) systems were damaged due to the fire and were not functioning. Hence, it was required to dispatch crew members to the passenger and crew decks to verbally inform the cabin occupants that there was a fire and they were to evacuate the accommodation and proceed to their nominated muster stations.
- 6.6 The Flexifog system was activated remotely from the main engine room. However, the system did not activate and required the manual intervention from the Chief Engineer to open the solenoid valves from the common manifold to the zone manifolds.
- 6.7 A distress call was sent to the Italian Coastguard, who initiated a rescue operation. Two coastguard vessels arrived on scene and began evacuating the passengers to the passenger ferry, 'ISLA DI VULCANO'. In total 105 passengers and 61 crew members were evacuated, leaving 30 crew members onboard.
- 6.8 The vessel was towed by the tug 'ANACAPRI' to the port of Naples, Italy.
- 6.9 There were no deaths, injuries or pollution reported due to the incident.

7. RECOMMENDATIONS

Recommendation for the operator:

- 7.1 Consider reviewing the Planned Maintenance System to incorporate the following:
 - 7.1.1 A periodic inspection regime of all fuel line securing arrangements.
 - 7.1.2 An inspection regime to verify the operation of all wire/pulley systems for remote opening/closing of fire dampers.
- 7.2 It is recommended to review the design mechanism of the fire damper system of the emergency generator room to prevent the inadvertent closing on the failure of the vessel's compressed air system.
- 7.3 It is recommended to have the fire alarm and all alarm systems synchronised to the vessel's master clock system at all times. If unable to synchronise, a procedure is to be implemented to account for any time difference between systems.

Appendix I: Autronica fire system report

	Page 1 of 1
REPORT	
Regarding:	Fire in the engine room on board Seadream yacht club's cruise ship Seadream 1
Reference no.:	AFS site no.
Manager:	Jon Arne Simonsen (Sales Manager)
People involved:	Asle Viken (Service Agent) Geir Ove Monsen (Autromaster expert), Geir Beitland (Service Manager)
File name:	20160928_Fire report_Seadream 1
Date:	2016-10-05

Autronica fire and security's report from log of the Autromaster in the fire system on-board.

We was requested by Seadream Yacht club to attend the ship after a fire broke out in the engine room on board the cruise ship Seadream 1 on Thursday 01th September 2016.

Our service manager Mr. Geir Beitland attended the vessel in Naples ,Italy on the 08. of September to check the Autronica systems after the fire in engine room. We saved a copy of the history log file in Autromaster 5000 graphical fire system on the bridge. This log saves all events in the fire system. We saved the log in our files for any questions after the fire.

On request from the owner we export this log and get time in a readable format from our expert on the Autromaster system Mr. Geir Ove Monsen. Note that the computer was not connected to a master clock so the date and time was not adjusted to local time zone. At the time Autronica engineer got on-board was the computer local time 4:34 hours late see picture below. So time stamp can be wrong according to local time settings on the computer on-board.



Date and time compare to Autronica engineers watch on the 09 of Sep. in Naples, Italy.

Mr. Geir Beitland filters the Alarm and Fault log and made this report. This is the alarms from the first 10 minutes of the fire as we find it in the system history log with the date and time on the Autromaster computer:

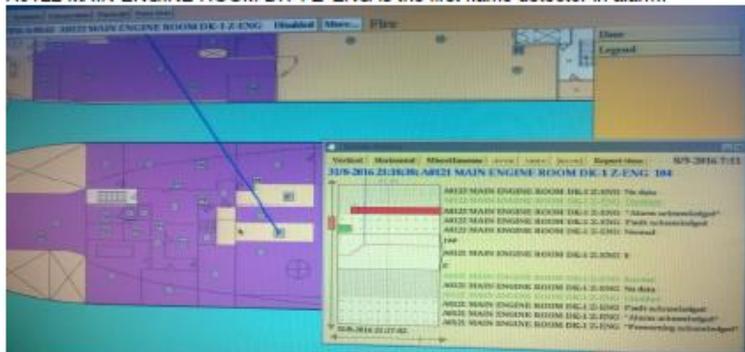
Tag (Detector no.)	Event status	Date and Time (as on the AM5000)
A0122 MAIN ENGINE ROOM DK-1 Z-ENG	Alarm	31.08.2016 21:17
A0120 MAIN ENGINE ROOM DK-1 Z-ENG	Alarm	31.08.2016 21:18
A0279 FUNNEL DK-2 Z-2	Alarm	31.08.2016 21:18
A0119 MAIN ENGINE ROOM DK-1 Z-ENG	Alarm	31.08.2016 21:18
A0126 SWITCH BOARD ROOM DK-1 Z-ENG	Alarm	31.08.2016 21:19
A BS100 Panel A	Earth fault	31.08.2016 21:19
A0140 ENG.STORE AREA DK-1 Z-ENG	Alarm	31.08.2016 21:19
A0127 SWITCH BOARD ROOM DK-1 Z-ENG	Alarm	31.08.2016 21:19
A0118 MAIN ENGINE ROOM DK-1 Z-ENG	Alarm	31.08.2016 21:19
A0129 CONTROL ROOM DK-1 Z-ENGINE	Alarm	31.08.2016 21:19

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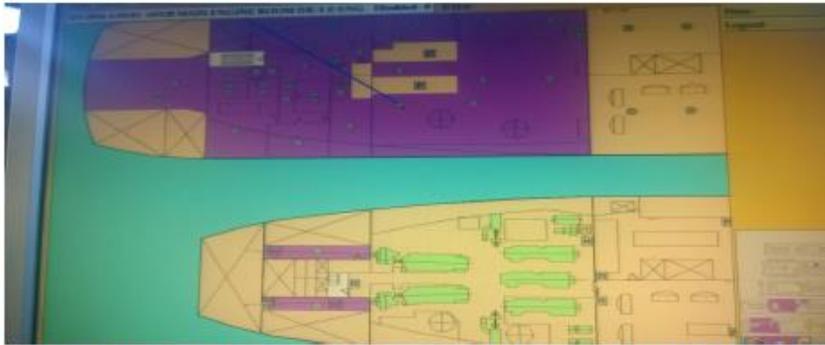
A BS100 Panel A	Earth fault	31.08.2016 21:19
A0145 GARBAGE RM.DK-1 Z-ENGINE	Alarm	31.08.2016 21:19
A0142 O/S ELECTRICAL W/S DK-1 Z-EN	Alarm	31.08.2016 21:19
A0106 COMPRESSOR RM DK-1 Z-ENGINE	Alarm	31.08.2016 21:19
A0157 MECH WKSHP LOBBY DK-1 Z-ENG	Alarm	31.08.2016 21:19
A0030 A/C ROOM DK-4 STBD Z-2	Alarm	31.08.2016 21:19
A01 BS100 Panel Loop 01	Faulty loop 1: short-circuited	31.08.2016 21:19
A0254 STAIR TO ENGINE DK-1 Z-2	Alarm	31.08.2016 21:19
A0255 GALLEY VENT DK-2 Z-2	Alarm	31.08.2016 21:20
A0209 CORRIDOR PORT AFT DK-2 Z-2	Alarm	31.08.2016 21:20
A0266 MAIN GALLEY PORT DK-2 Z-2	Alarm	31.08.2016 21:20
A0031 A/C ROOM DK-4 PORT Z-2	Alarm	31.08.2016 21:20
A0201 DINING RM STBD FWD DK-2 Z-2	Alarm	31.08.2016 21:21
A0208 CORRIDOR PORT MID DK-2 Z-2	Alarm	31.08.2016 21:22
A0247 FIRE DOOR 308 DK-3 Z-2	Fault	31.08.2016 21:22
A0216 OFFICERS MESS DK-2 Z-2	Alarm	31.08.2016 21:22
A0213 CREW PANTRY PORT DK-2 Z-2	Alarm	31.08.2016 21:22
A0212 CREW MESS MID PORT DK-2 Z-2	Alarm	31.08.2016 21:22
A0249 FIRE DOOR 309 DK-3 Z-2	Fault	31.08.2016 21:22
A0706 FIRE SPRINKLER DECK 1/2 AFT	Alarm	31.08.2016 21:22
A0261 FIRE DOOR 217 DK-2 Z-2	Fault	31.08.2016 21:23
A0263 FIRE DOOR 216 DK-2 Z-2	Fault	31.08.2016 21:23
A0278 DUMB WAITER DK-3 Z-2	Fault	31.08.2016 21:23
A0204 DINING RM MID AFT DK-2 Z-2	Alarm	31.08.2016 21:23
A0217 PANTRY OFF P-S MESS DK-2 Z-2	Alarm	31.08.2016 21:24
A0224 SERVICE CORRIDOR DK-2 Z-2	Alarm	31.08.2016 21:25
A0023 LOUNGE DK-4 PORT AFT Z-2	Alarm	31.08.2016 21:26
A0225 SERVICE STAIR DK-1 Z-2	Alarm	31.08.2016 21:27
A0220 SERVICE CORRIDOR DK-2 Z-2	Alarm	31.08.2016 21:27
A0227 SERVICE STAIRCASE TT Z-2	Alarm	31.08.2016 21:27
A0206 BAKERY STORE U/STAIR DK2 Z-2	Alarm	31.08.2016 21:27
A0207 BAKERY STORE U/STAIR DK2 Z-2	Alarm	31.08.2016 21:27

A0122 MAIN ENGINE ROOM DK-1 Z-ENG is the first flame detector in alarm.



Picture form Autromaster

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After this alarm many smoke detectors go direct in alarm All the 15 first detectors are displayed and give alarm on the BS-100 central and on the Autromaster 5000 graphical computer on the bridge. During the first 2 minutes was all detectors in the engine areas and detector no. A0279 FUNNEL DK-2 Z-2 in the casing on Deck 02 in alarm.

We also see that the system get 3 faults on the BS-100 panel: Earth fault and Short Circuited with in the 2 min. after the fire start. This indicate that the loop cabel was melted becuse of the heat in the engine room.

A BS100 Panel A	Earth fault	31.08.2016 21:19
A01 BS100 Panel Loop 01	Faulty loop 1: short-circuited	31.08.2016 21:19

Evaluation after the fire based on the log and the observation on the survey on the ship:

Fire started in the Main engine on starboard side on deck 01. Than the smoke spread quickly in the casing and engine areas. After 3 minutes do the first detectors go in Alarm on loop 02 outside engine areas :

A0254 STAIR TO ENGINE DK-1 Z-2
A0255 GALLEY VENT DK-2 Z-2

Total 64 alarms was on the system from the start Date 2016.Sep.01 clock 01:51 (adjusted 4.34 Hours from AM5000 time) to the last alarm was acknowledge at date 2016.Sep.01 clock 02:21. There were 37 detectors in alarm the first 10 minutes of the fire. Most of the detectors giving alarm were probably because the smoke spread with the air around the ship. The first 30 minutes there were 64 alarms and 699 events in the log still several hours more event are logged in the raw data file and can be exported.

The BS-100 central and the Autromaster 5000 (AM5000) graphical fire presentations computer on the bridge was operational during the fire.

The fire was in the end extinguished by the Flexifog water mist system after it was maualy released. No Automatic function.

We test the fire and general alarm Monday 12th. of Sep. to check after the fire.The 220V AC fuse supplying the fire cabinet triped because of short curicit on the bells cables.This stoped the alarm bells form working. The BS-100 central was still working on battery.

Equipment damage on the Autronica systems:

All the electronic in the detectors giving alarm are damage by the fire or smoke. All equipment in the engine room and casing must be change: detectors, Alarm sirens, Bells, Alarm Lights, Door I/O units, Nodes, Manual call points, Local Release buttons, all cable on the systems. Because of high current and short circuit between cables more equipment can be damage.

The BS-100 system and parts are obsolete so we strongly recommend to refit the central and all unints on loop 01 and 02.

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REPORT – Fire in the engine room on board Seadream yacht club's cruise ship Seadream 10-05 Page 4 of 4

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Appendix II: Autronica Flexifog system report

	REPORT	Page 1 of 1
Regarding:	Fire in the engine room on board Seadream yacht club's cruise ship Seadream 1	
Reference no.:	AFS site no SH_40453952.	
Manager:	Jan Thomas Hellener (Sales Manager)	
People involved:	Asle Viken (Service Agent), Geir Beitland (Service Manager)	
File name:	20161020_Fire report_Flexifog_System_Seadream 1_rev.1	
Date:	2016-11-04	

Autronica fire and security's report for the Water mist system FlexiFog after the fire system on-board.

We were requested by Seadream Yacht club to attend the ship after a fire broke out in the engine room on board the cruise ship Seadream 1 on Thursday 01th September 2016.

Our service manager Mr. Geir Beitland and Mr. Asle Viken from High Seas Trading attended the vessel in Naples, Italy on the 08.of September to check the Autronica systems after the fire in engine room.

We know from our investigation and information from the ship officers that the fire in the end was extinguished by the FlexiFog water mist system after manually released. The system in the engine room are covering these zones:

High Risk System Zones :

- Main Engines,
- Auxiliary Engines,
- Boiler 1,
- Boiler 2,

Total flooding all zones:

- Bilge + Main Engines + Auxiliary Engines+ Boiler 1 and Boiler 2

We don't have log of events in the Flexifog system so to easier to understand the time line and effect of our "findings" described below we talk with some of the crew.

The Fire incident, Step-By-Step, as verbally told to Mr. Asle Viken. **Summary is by no way a report on the three Gentlemen's action during the fire.**

The one crew member on-duty enters the engine room through FW watertight door and notices a fuel leak on the inside bank on STBD Main Engine and see the fire.
 He grabs a nearby "on-wheel" 50 KG powder fire extinguisher and tries to extinguish the fire.
 He gives up his attempt due to increasing flame and heat insensitivity and retreat through the same WT door as he entered. The local release switch for the FlexiFog system was not used.
 He then closes the WT door and leaves the engine area through the FWD port side exit.
 The on-duty officer in the control room see the fuel "low pressure" alarm goes off.
 He leaves the control room and enters the engine room through the aft entry door, to investigate.
 He is met by the same intensive fire, retreat, closes the door and return to the engine control room.
 He activates the FlexiFog system "Main Engine High Risk" zone, call and informs the Chief Engineer, then leaves the control room through the aft exit toward the mooring deck.
 The Chief Engineer heads for the Safety Central, where he activates all remote "Fuel-quick-closing Valves", shut down the ventilation fans, and closes all Ventilation dampers.

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He later enters the "Pump room" where the FlexiFog control unit is located to make sure the system is operating.

He finds all three pumps running, with approximately 16 BAR on the manifold, but no pressure on the "activated" Main Engine High Risk" zone, which was earlier released from the engine control room.

He then activates all "Engine room" zone valves manually from the pump station.

One of the manual valve actuator would not "stay" in open position, and he adds one C-clamp to keep the valve in open position. He also starts the "Foam pump" manually.

All zones in Total Flooding system were pressurised and pumps water to the all nozzles in the engine room they create water mist that extinguish the fire.

Findings:

Profibus Interface.

The cable and nodes in the engine room was burn and stop functioning early in the fire. From the faults in the fire detection log we see this happen after 2 minutes from the first alarm.

Below picture shows what is left of the Node for "Boiler 1+2".



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Below picture show the location where the "Main Engine" node was located.



Based on above missing (disintegrated) Node we conclude that the zone valve lost its 24 VDC supply immediately when the cables short circuited.
With the 24 VDC gone, the valve closed, cutting off the water supply to the nozzle grid.
The system is without an event log, so it's impossible to say when this happened.
When the officer on-duty in the ECR activated the system was probably the 24V DC on, since the pressure switch, located after the zone valve, turned on the "System released" light in the control room.
It was gone by the time the Chief Engineer reached the pump unit.

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Foam System.

Below picture shows the foam valve.



This valve is activated from the same 24 VDC supply as the zone valves, and lost its activation power when the Profibus Interface cables short circuited. This valve is without a manual override.

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Main Engine High Risk Nozzle grid.

Below picture shows the "missing" nozzle location.



Above empty pipe fitting is where the missing nozzle should have been (was) installed. The missing nozzle created a deluge in the area instead of a fine water mist blanket. We don't know when the nozzle was removed.

Evaluation after the fire based the observation on the survey on the ship:

Fire started in the Main engine on starboard side on deck 01.

The Flexifog control cabinet and pumps in the pump room was operational during the fire.

The following "Faults" were observed either during or after the fire (see also pictures and discription above):

- The local release switch for the FlexiFog system in Main engine room was not used.
- Main Engine High Risk valve were closed, even though it was activated from the control room. The zone valve lost its 24 VDC supply immediately when the cables short circuited by the fire. The valve was manually open in the pumproom after some time by Ch. Eng.
- No evidence that foam arrived at the nozzles, as designed, even though the pump was running. The foam valve is activated from the same 24 VDC supply as the zone valves, and lost its activation power when the Profibus Interface cables short circuited by the fire. This valve is not possible to open manually.
- One nozzle was missing in the Main Engine High Risk nozzle grid, which is located in the short hallway just before the aft exit door. We don't know when the nozzle was removed.

The fire was in the end extinguished by the Flexifog water mist system after it was manually released. No Automatic function was installed. The time before activation of the system was longer than the fire needed to melt and short circuit the cables going from the Engine control room to the Flexifog control system and the valves in the pumproom.

Equipment damage on the Autronica systems:

All equipment in the engine room and casing must be change: Local release buttons, Alarm sirens, Bells, Alarm Lights, Nodes, Nozzles and piping that didn't hold the pressure test, all cable on the systems. Because of high current and short circuit between cables more equipment can be damage.

Autronica Fire and Security AS

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Recommendation:

- We strongly recommend to install automatic release of the High Risk zones from the fire alarm system.
- Instruct ships officers to drill on fire in engine and the critical time limit to activate local protection water mist.
- Pull cables different routing in engine room or outside if possible.
- Add battery backup on 24V to control cabinet and panels for control of valves and pump.

Autronica Fire and Security AS

Appendix III: Hans Backens Elektronik GmbH PA/GA service report

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PA / GA Service
M/S „SeaDream 1“
Damage Assessment
Service Report

Project: A0 9608
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Travel and Work Schedule:

12.09.16. Travel from Schwentinental – Germany to MV “SeaDream 1” at Napoli – Italy;

- Meeting with:
- Director Marine Operation,
 - Chief Engineer,
 - 1st Electrician;

Retrieving information on PA system behaviour during and after fire;
Inspection of PA system components, with good results;
Inspection of PA system programming, with partly negative result;
Re-programming of SM-30 system;
Internal test of PA system, with good results;
Measuring of loudspeaker network lines, with partly negative result;
Repairs in loudspeaker network, with partly positive result;

13.09.16. Measuring of loudspeaker network lines, with partly negative result;

Repairs in loudspeaker network, with partly positive result;
Test of PA/GA function with negative result;
Fault finding, discussion and fault elimination process;
Repeated test of PA/GA function with positive result;
Inspection of PA/GA System with LR, with positive result;
Continuing of miscellaneous works;
Return travel to HBE home base;

Remaining “todo” list for ship’s crew

- Cable 3771-51 at JB 52, trace and correct function of non-identified line cable;
- Cable 3771-53 at JB 53, trace and correct earth fault in crew cabins;
- Cable 3771-7B2 at el. Workshop, add transformer to low impedance speaker;
- Cable 3771-84, reconnect cable after earth faults are gone, test complete line;
- Cable 3771-85, reconnect cable after earth faults are gone, test complete line;
- Cable 3771-87, reconnect cable after earth faults are gone, test complete line;
- This open item list is handed out to the fist electrician for required check-up and solving needs;
- Please do contact HBE if there might be assistance required.

Technical Report in detail: Please see pages 2 – 5

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Technical Report in detail:

1. PA / GA central

Inspection of SM-30 central and SQ-45 amplifier;

General:

- Temperature of the components is within the normal range;
- A dust layer was found on- and inside the equipment;
⇒ HBE does recommend to vacuum clean the central rack and its components once per year, or more often if found necessary. Dust may lead to higher operation temperatures and thus to reduction in lifetime. Thick dust layers do bear higher risk of fire;

SM-30 system:

- The unit is in normal condition and does not have mechanical damages;
- The display did show “failure call station 2 and 3”;
⇒ This behaviour was correct, as both call station are not connected, but still existent in the programming. Call station 2 (Radio Room) and 3 (Engine Control Room) are no longer in use. One call station does exist as a spare one.
- All cable connections were found in correct order.
- The spare call station was connected to call station input 2. The fault message disappeared, the unit became fully functional.
- During inspection of the programming the unit did erase all of its customer programming, without being commanded to do so, and further re-established “factory setting”.
⇒ This behaviour was not correct. Unacknowledged erase of customer programming and return to factory setting should not happen under any circumstances.
⇒ The unit was re-programmed and its behaviour several times complete tested. No glitches could get found. The system operated as programmed and instructed.
➔ **The behaviour of the SM-30 system should get monitored for during the next weeks. It must get replaced if not authorised program erase will happen again. Please do contact HBE if there might be assistance required;**

SQ-45 amplifier:

- The units are in normal condition and does not have mechanical damages;
- All cable connections were found in correct order;
- No functional defects could get found.
⇒ HBE does recommend to service and calibrate the amplifiers approximately every ten years.
⇒ Partly dried-out condensers are noticeable reducing the power capacity by then.
⇒ Servicing of amplifiers does expand the possible lifetime of amplifiers considerably.
⇒ Required amplifier repairs can be handles at the same time.
⇒ Measurement certificates are delivered for all tested and repaired amplifiers.

Music components:

- The units are in normal condition and does not have mechanical damages;
- All cable connections were found in correct order;
- No function tests were executed;

1. PA / GA central (cont.)

Loudspeaker network:

- The outgoing distribution cable were measured for loudspeaker power over load and existent earth faults in cabling and equipment;
- Several faults in the loudspeaker power load were found. Heavy load faults do become audible by partly interrupted (cutting up) sound;
 - ⇒ Some of these faults were traced and could get repaired.
 - ⇒ One fault could get traced, but repair is not possible reasoned by lack of on-board spare parts.
 - ➔ Some of the faults are in connection with the damaged area and could therefore not get repaired. We do anticipate that these faults should get solved with exchange of the damaged cables.
 - ➔ An open item list is handed out to the fist electrician for required check-up and solving needs;
 - ⇒ All affected cables are disconnected, either at the central or at a local distribution box. The rest of the remaining amplifier loop is working normal.
- Several earth faults in the loudspeaker cabling were found. Earth faults may become audible by partly interrupted (cutting up) sound.
 - ⇒ Some of these faults were traced and could get repaired.
 - ⇒ Some of these faults were partly traced, but could not get repaired, reasoned by lack of time.
 - ➔ Some of the faults are in connection with the damaged area and could therefore not get repaired. We do anticipate that these faults should get solved with exchange of the damaged cables.
 - ➔ An open item list is handed out to the fist electrician for required check-up and solving needs;
 - ⇒ All affected cables are disconnected, either at the central or at a local distribution box. The rest of the remaining amplifier loop is working normal.

2. PA / GA Call Stations

Call Station, Bridge:

- The unit is in normal condition and does not have mechanical damages;
- The cable connections was found in correct order;
- No functional defects could get found.

Call Station, Reception:

- The unit is in normal condition and does not have mechanical damages;
- The cable connections was found in correct order;
- No functional defects could get found.

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3. PA / GA Alarm Station and PLC with Relays

Alarm Panel, Bridge:

- The unit is installed in the top of the Autronica Fire Detection Cabinet, wheelhouse;
- It is partly damaged, as pushbutton cover lids do no longer stay locked if opened for operation. This has no functional influence. Some illumination lamps were found defective and repaired.
- The cable connections were not inspected.
- No functional defects could get found;

PLC with Relays, Bridge:

- The units are installed inside the Autronica Fire Detection Cabinet, wheelhouse;
- The unit is in normal condition and does not have mechanical damages;
- The cable connections was found in correct order.
- No functional defects could get found;

4. PA / GA Function Test

Announcement:

- Complete test of the announcement function was done with positive results.

Alarms:

- Test of the alarm function “General Alarm Crew” was done with negative result;
- The alarm signal was audible for a brief moment only. Any further operational attempt did not show any result;
- Fault finding measures revealed, that with activation an alarm signal, one contact, for simultaneous activation of the alarm bells, gets activated too;
 - ⇒ As some power loops of the alarm bells got damaged by the fire, the existent short connections in these cable lines triggered a fuse to blow;
 - ⇒ The AC powered parts of the FDS system, including the PA/GA PLC, had no longer power and stopped to function, in result of this;
 - ⇒ The tripped fuse (10A-L) is located inside junction box 502, located on the bridge;
 - ⇒ The fuse inside the FDS central (10A-K) should have reacted, but did not;
- ➔ We have all reason to believe that this is the background scenario, which did come up during and/or after the fire, and did lead to the situation which was described by several people, with a none functioning PA system;
- ➔ HBE does strongly recommend separation of the PA/GA’s AC power supply from the FDS ones, for stabilisation and securing of system function. Such would require a new power cable, from box 502 to the FDS central, and one new 24V/DC power supply, for separating the PA/GA relay function from the FDS power supply too. (Please do contact HBE if there might be assistance required)

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4. PA / GA Function Test (cont.)

- After isolating the faulty alarm belt cables and reset of the AC fuse, the FDS's AC power got re-established. The PLC returned to function with audible alarm activation, as it lost function within an activated alarm. The alarm was manually stopped;
- The repeated test of the GA Crew, and all of the other alarms, did function with positive results. The contact for activation of the alarm bells did work too, as would have the alarm bells, if connected.

5. LR inspection of the system

Several parts of the PA/GA system were surveyed from the LR inspector:

- It was protocolled that the cables 3771-84, 3771-85 and 3771-87 were disconnected in the PA central, reasoned by damages in the cabling, and thus resulting in non-functional passenger outside areas, mainly at the aft of the vessel. These cables are to be re-connected after the existent faults are gone, to re-establish required system function;
- PA functions of the system were demonstrated and tested by use of the connected spare call station at the central rack, with positive result;
- PA functions of the system were demonstrated and tested by use of the wheelhouse call station, with positive result;
- Alarm functions of the system were demonstrated and tested by use of the wheelhouse alarm station, with positive result;
- Some parts of the loudspeaker network were tested by local inspection of several areas. The passenger corridors, passenger and crew cabins were excluded from this test, to not to disturb the night watch working people. The test was done with Music picked up by the microphone of the wheelhouse call station, with all areas selected (F4). The test was finished with positive result;

6. Remaining "todo" list for ship's crew

- Cable 3771-51 at JB 52, trace and correct function of non-identified line cable;
- Cable 3771-53 at JB 53, trace and correct earth fault in crew cabins;
- Cable 3771-7B2 at el. Workshop, add transformer to low impedance speaker;
- Cable 3771-84, reconnect cable after earth faults are gone, test complete line;
- Cable 3771-85, reconnect cable after earth faults are gone, test complete line;
- Cable 3771-87, reconnect cable after earth faults are gone, test complete line;
- This open item list is handed out to the fist electrician for required check-up and solving needs;
 - ➔ HBE does recommend regular service on the loudspeaker network, including amplifier load measurements, ground fault check and sound pressure measurements of the alarm tone and emergency announcement.
- Please do contact HBE if there might be assistance required.
