THE COMMONWEALTH OF THE BAHAMAS

M.V. Norwegian Escape

IMO Number: 9677076
Official Number: 7000746

Report of the marine safety investigation into serious crew injuries on a Passenger vessel on 27 November 2018

The Bahamas conducts marine safety or other investigations on ships flying the flag of the Commonwealth of the Bahamas in accordance with the obligations set forth in International Conventions to which The Bahamas is a Party. In accordance with the IMO Casualty Investigation Code, mandated by the International Convention for the Safety of Life at Sea (SOLAS) Regulation XI-1/6, investigations have the objective of preventing marine casualties and marine incidents in the future and do not seek to apportion blame or determine liability.

It should be noted that the Bahamas Merchant Shipping Act, Para 170 (2) requires officers of a ship involved in an accident to answer an Inspector's questions fully and truly. If the contents of a report were subsequently submitted as evidence in court proceedings relating to an accident this could offend the principle that a person cannot be required to give evidence against themselves. The Bahamas Maritime Authority makes this report available to any interested individuals, organizations, agencies or States on the strict understanding that it will not be used as evidence in any legal proceedings anywhere in the world. You must re-use it accurately and not in a misleading context. Any material used must contain the title of the source publication and where we have identified any third-party copyright material you will need to obtain permission from the copyright holders concerned.

Date of Issue: 21 October 2019

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1 GLOSSARY OF ABBREVIATIONS AND ACRONYMS

°C	Degree Celsius
AB	Able Body Seaman
BMA	Bahamas Maritime Authority
CCTV	Closed-Circuit Television
EDS	Energy dispersive X-ray spectroscopy
IMO	International Maritime Organization
MMSI	Maritime Mobile Service Identity
NCL	Norwegian Cruise Line
PPE	Personal Protective Equipment
SCC	Stress corrosion cracking
SMS	Safety Management System
USA	United States of America
USCG	United States Coast Guard
UTC	Universal Time Coordinated

All times noted in the report are given in the style of the standard 24-hour clock without additional annotation and as local time, which was UTC -5.

2 SUMMARY

2.1 On 26 November 2018, the vessel was underway to Port Canaveral with 1729 crew members and 3921 passengers on board. At 1030 hours the Assistant Engineer observed a leakage around the vicinity of insulated hot potable water pipe in Engine room on deck 2. The Assistant Engineer informed the First Engineer and it was decided to tighten the coupling to stop the leak.

2.2 The Motorman and Oiler were tasked to remove the insulation material and tighten the coupling while the system was under operation with water at a pressure of 8 to 9 Bars and with a temperature of around 65°C.

2.3 Access to the leak was restricted and in order to complete the work activity, the Oiler and Motorman had to position themselves between the hot potable water pipeline and starboard side bulkhead.

2.4 The crew members tightened one coupling on the forward side. However, the leak was still observed from the aft section of pipe, the Motorman tried to tighten the aft coupling and found that the bolt on the coupling was loose. Subsequently the coupling failed, resulting in the pressurized release of steam and hot water.

2.5 The Motorman and Oiler exited the scene using the opening access for the pipelines on deck 2-floor plate, transiting down towards deck 1. Both crew members suffered severe burn injuries due to the exposure to steam and hot water.

2.6 A code Alpha was raised and as a result, first aid treatment was provided by the on board medical team until both crew members were medically evacuated by a United States Coast Guard (USCG) helicopter to Jaycee Burn Center in North Carolina, USA whereupon further medical treatment was provided to them.

2.7 From the independent forensic laboratory evaluation report of the failed coupling it was determined that the coupling failed due to stress corrosion cracking due to exposure of chlorinated water. The likely source of chlorinated water is the leakage through the gasket to the pipe interface. However, it could not be determined if the leakage occurred as a result of a deteriorating gasket or due to faulty installation of the coupling.

2.8 This marine safety investigation was classified as a serious marine safety investigation in accordance with Chapter 2 of the MSC.255(84)[1]. Additionally, no marine pollution was caused as a result of this marine accident.

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[1] Code for the International Standards and Recommended Practices for a Safety Investigations into a Marine Casualty or Marine Incident (Casualty Investigation Code).

3 DETAILS OF INVOLVED VESSEL(s) AND OTHER MATTERS

3.1 Details of the vessel

3.1.1 M.V. Norwegian Escape is a passenger ship built in Meyer Werft shipyard in Papenburg, Germany on 22 October 2015.

3.1.2 The vessel had the following principal particulars:

Call sign	C6BR3
IMO number	9677076
MMSI number	311 000 341
Built	2015
Length overall	325.9 metres
Length between perpendiculars	300.2 metres
Breadth	41.40 metres
Depth moulded	14.40 metres
Gross registered tonnage	165157.00 tonnes
Net registered tonnage	134779.00 tonnes
Type	Passenger ship

3.1.3 At the time of the incident, the vessel was owned by Breakaway Three, Ltd. and managed by Norwegian Cruise Line (Bahamas) Ltd.

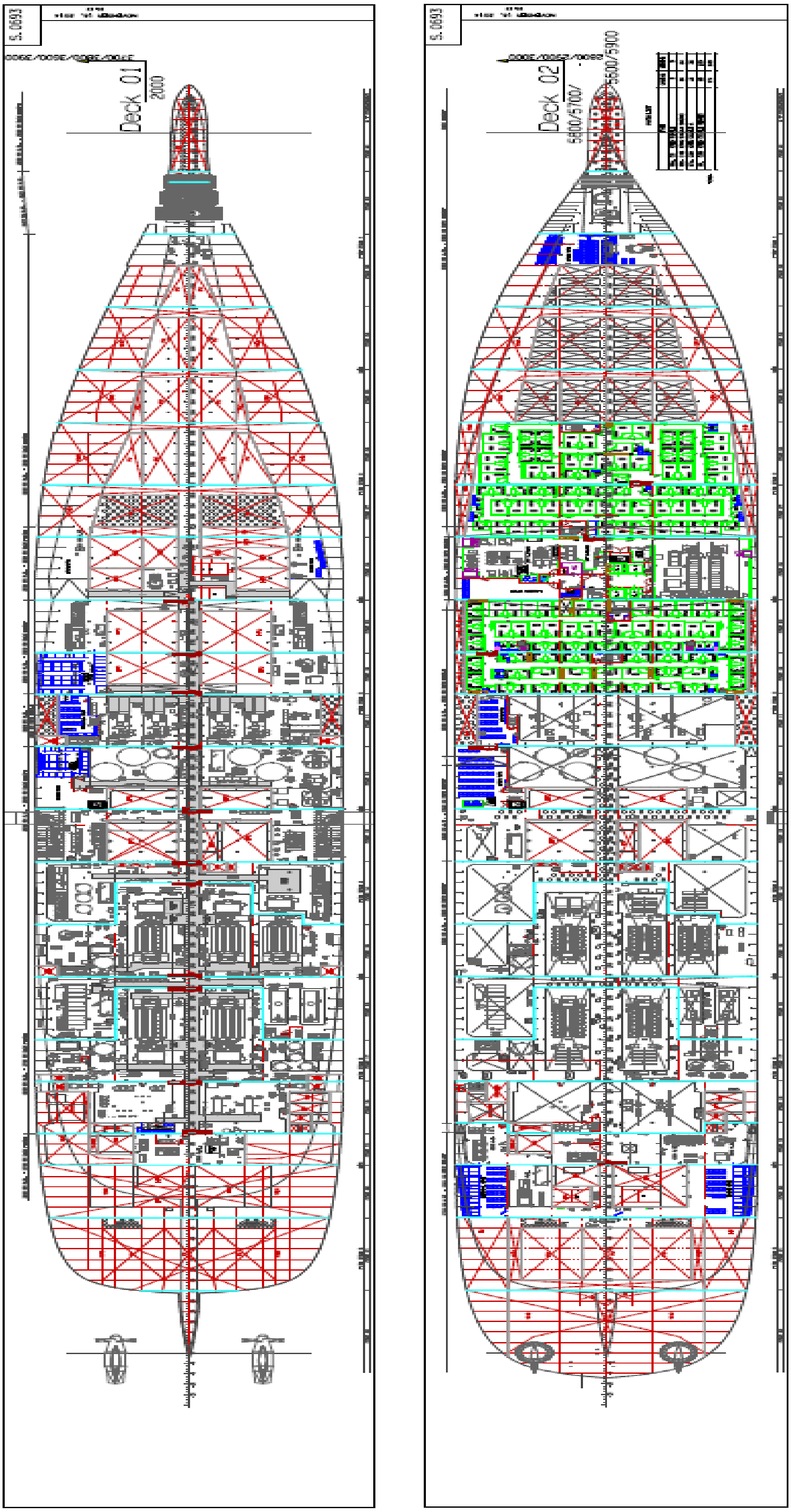

Figure 1: M.V. Norwegian Escape general arrangement plan of deck 1 and deck 2

3.2 Vessel Certification

3.2.1 M.V. Norwegian Escape was permanently registered with the Bahamas Maritime Authority (BMA) from 28 September 2016 and was classed with DNV GL Classification Society. At the time of the incident, the vessel complied with all statutory and international requirements and certification.

3.2.2 The vessel was subjected to a Bahamas Maritime Authority Annual Inspection at the Port of New York on 18 November 2018. One deficiency was recorded regarding a double fire door not closing properly which is determined to be unrelated to this marine casualty.

3.2.3 The vessel had a Port State Control Inspection at the Port of New York on 28 October 2018 with no deficiencies identified.

3.3 Hot potable water system

3.3.1 The hot potable water system consists of hot potable circulation pumps, water heaters, heat recovery exchange and the pipelines. The system has insulated[2] copper pipelines with steel couplings used to connect the pipes.

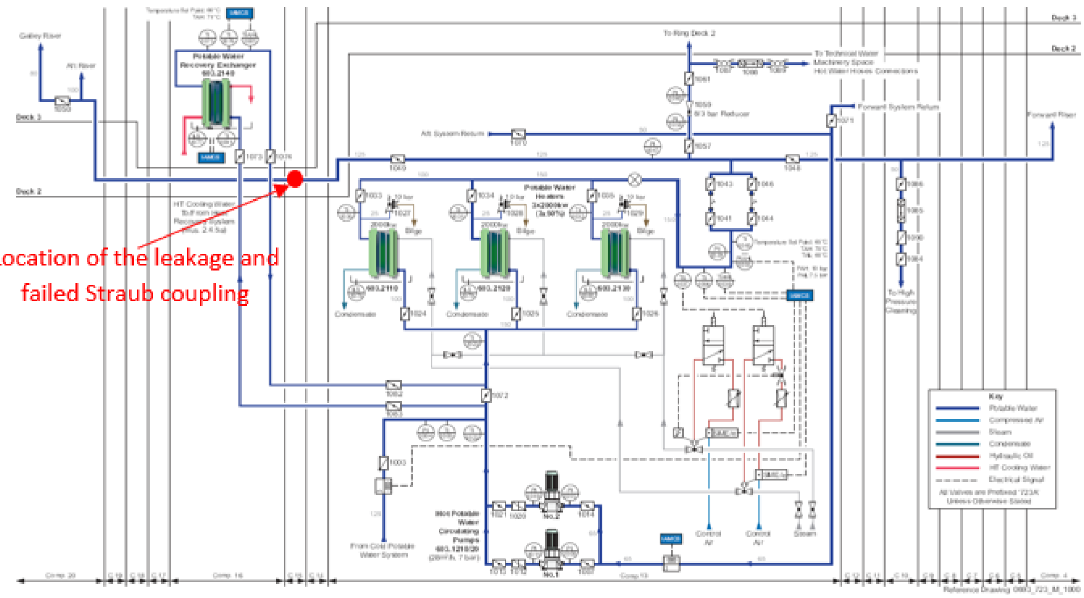

Figure 2: Hot potable water system (Source: Norwegian Escape Technical Operating Manual)

3.3.2 The hot potable water is circulated around the ship in a number of separate loops, which are interconnected.

3.3.3 Water is continuously circulated through the loops to ensure that water at the desired temperature is constantly available at all outlets.

[2] The insulation material used on the pipelines and coupling of the hot potable water system had the chemical behaviour compliant with the Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel (ASTM C 795).

3.3.4 The heater control system maintains a constant temperature of approximately 65°C in the hot water system.

3.3.5 The system operating pressure is designed between 8-9 bar.

3.4 Coupling design

3.4.1 The coupling on the hot potable water pipeline was Teekay's[3] Axilock-S type.

3.4.2 The coupling had two anchor rings which are placed adjacent to, but separate from, the sealing mechanism.

3.4.3 As the lockpart is tightened the sealing lips are pressed against the pipe surface to form a seal. At the same time, the anchor rings penetrate the rubber, bite into the two pipes and prevent them from pulling apart, whether by external loading or internal pressure.

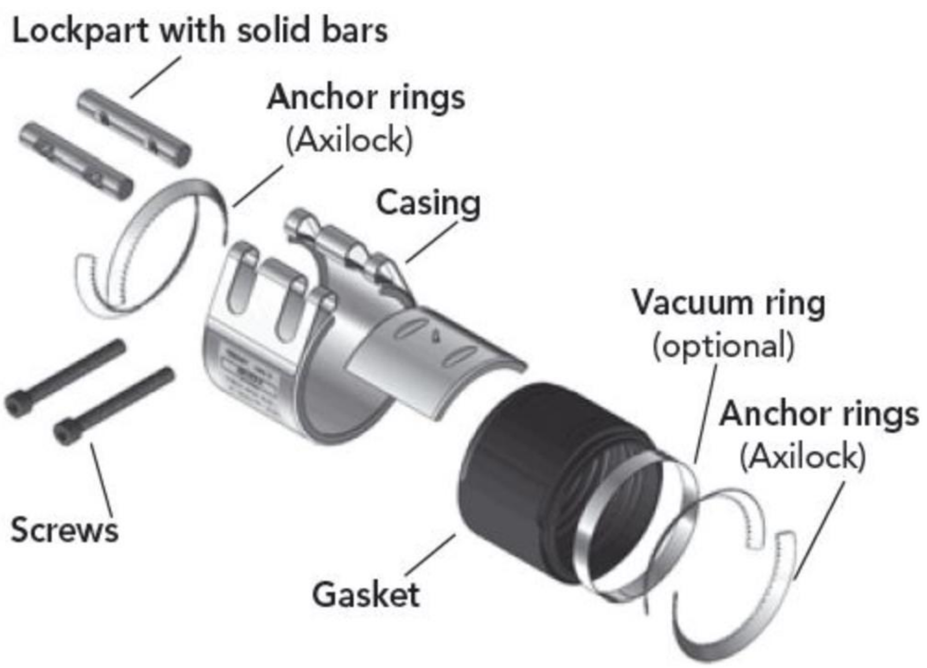

Figure 3: Axilock coupling's parts (Source: Teekay pipe coupling website)

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[3] Teekay coupling is a Teekay trademarked product manufactured by Taylor Kerr (Engineering) Ltd registered in England & Wales.

4 NARRATIVE OF EVENTS

4.1 On 25 November 2018 at 1558 the vessel departed port from New York to Port Canaveral with 1729 crew members and 3921 passengers on board.

4.2 On 26 November 2018 at 1030 hours the Assistant Engineer arrived at deck 2, compartment 15 of the engine room and observed a leakage around the insulated hot potable water pipeline.

Figure 4: Location of hot potable water pipeline where leakage was observed

4.3 At 1033 hours the Assistant Engineer left the vicinity of the leak.

4.4 At 1041 the Assistant Engineer returned with a Motorman and Oiler at the vicinity.

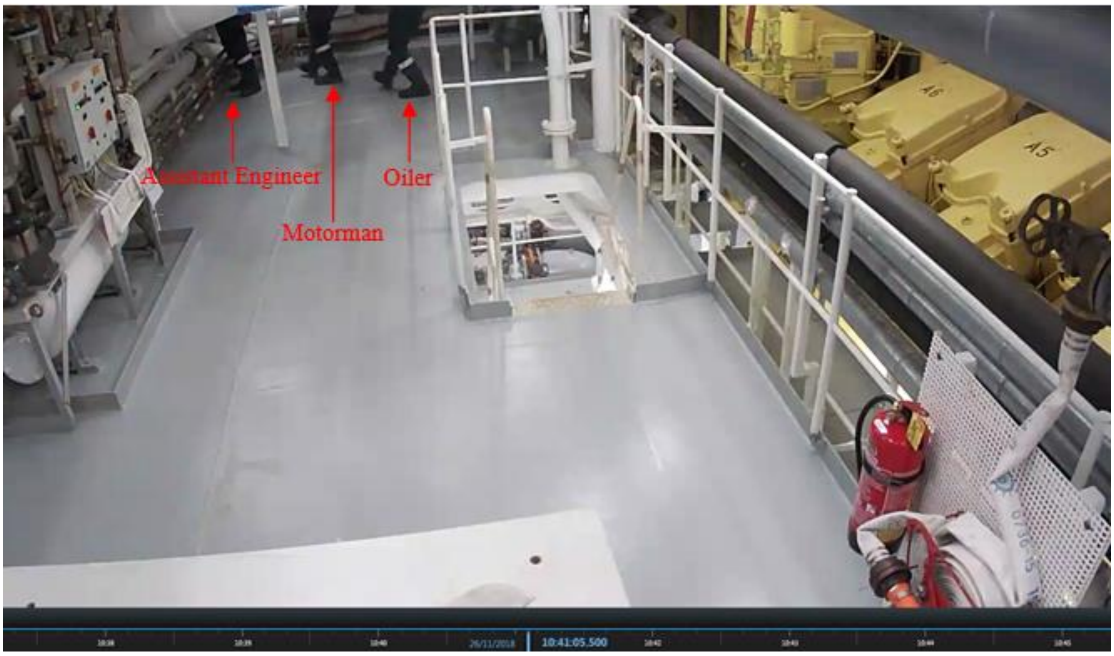

Figure 5: CCTV footage screenshot of Assistant Engineer arriving with Motorman and Oiler

4.5 The 3 crew members examined the area and the leak. Moments later the Motorman and Oiler left the vicinity.

4.6 At 1045 the Oiler came back and went behind the pipelines toward the starboard bulkhead.

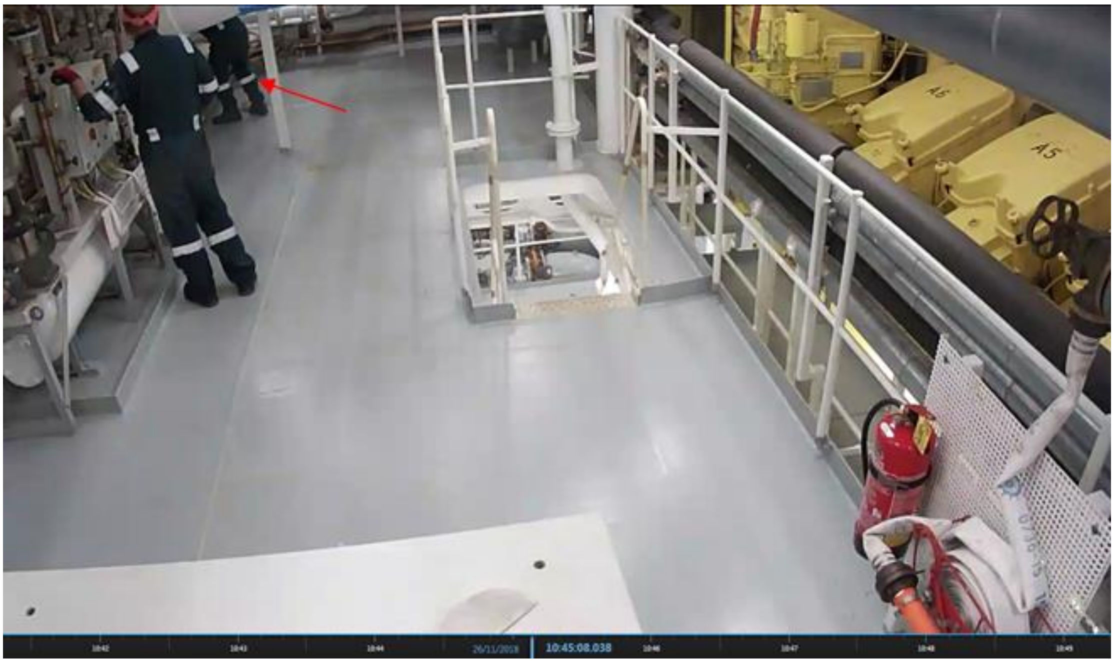

Figure 6: CCTV footage screenshot of Oiler going behind the pipelines toward the starboard bulkhead

4.7 The Assistant Engineer went towards deck 1 and the Motorman arrived at the vicinity of the leak. Moments later the Motorman also went behind the pipelines toward the starboard side bulkhead. The crew members decided to cut the insulation material around the pipeline to access the couplings.

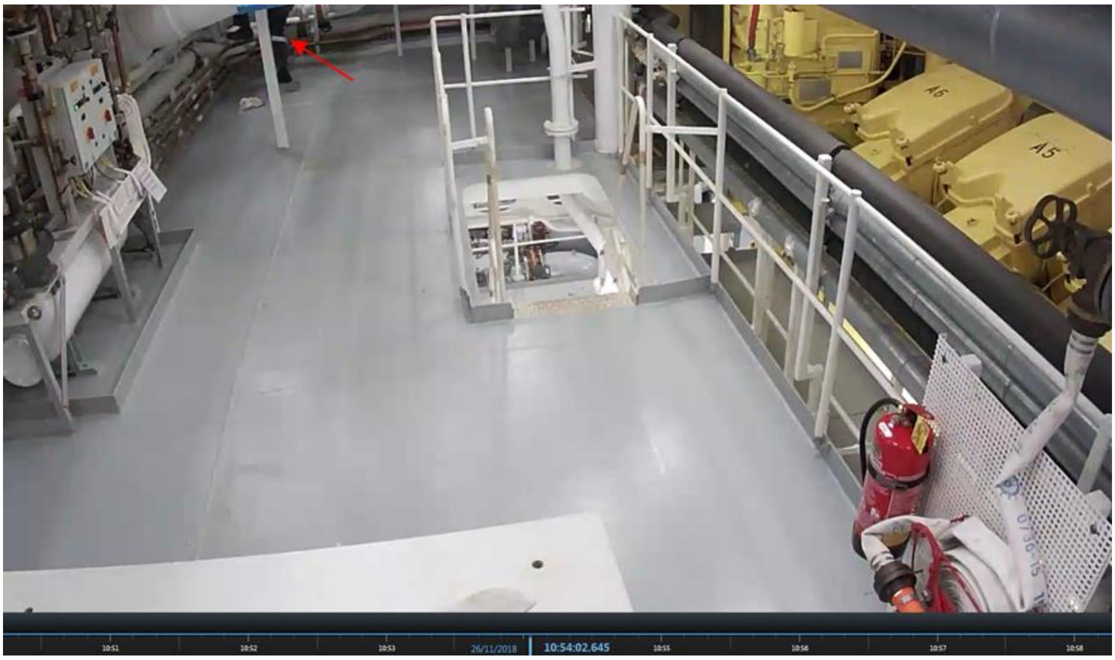

Figure 7: CCTV footage screenshot of Motorman going behind the pipelines toward the starboard bulkhead

4.8 At 1051 hours the Motorman left the vicinity and subsequently returned at 1053 hours.

4.9 At 1058 hours the Oiler left the vicinity and subsequently returned at 1100 hours with a torque wrench in hand, to tighten a coupling on the hot potable water pipe.

4.10 At 1102 hours the Motorman left and Assistant Engineer arrived back in the vicinity with waste cloths pieces in hand and placed them near the vicinity of the leak.

4.11 At 1108 the Motorman returned to the vicinity with a cleaning mop and cleaned the area near the leakage area.

4.12 The crew members observed the leakage was not fully rectified and decided to open the insulation further to access another coupling in the aft section of the same pipeline after their lunch break.

4.13 At 1114 hours the three crew members left.

4.14 At 1309 hours the Oiler returned to the vicinity and left at 1310 hours.

4.15 At 1317 hours the Motorman and Oiler returned to the vicinity with a roll of new insulation material. Both personnel went behind the hot potable water pipeline towards the starboard side bulkhead to rectify the leak on the hot potable water pipeline.

4.16 At 1333 and 1343 hours, the Oiler went to deck 1 and returned with a strap and tool in hand.

4.17 At 1354 the Motorman went to deck 1 and at 1357 hours he returned with plastic bags in hand. The Assistant Engineer also returned to the vicinity. The Motorman then went behind the pipelines.

4.18 At 1407 the Oiler and Motorman were located inwards, between the hot potable water pipeline and starboard side bulkhead. The Assistant Engineer was standing outward of the pipelines.

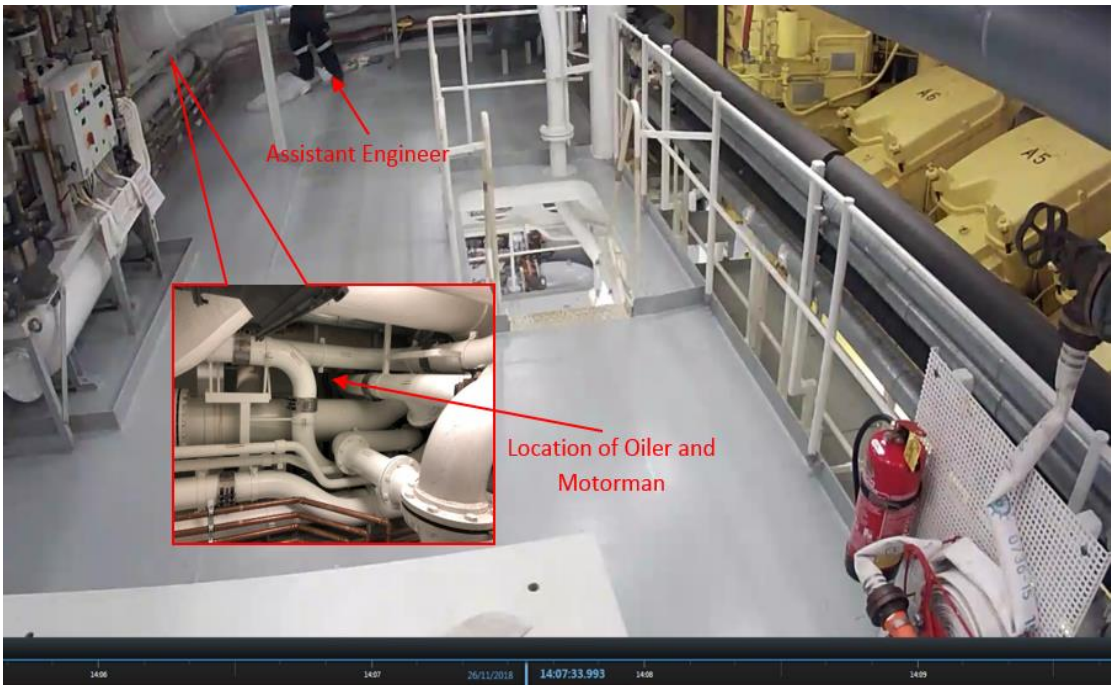

Figure 8: Location of Oiler, Motorman and Assistant Engineer at 1407 hours

4.19 A few moments later as the Motorman tried to tighten the aft coupling having found that the bolt on coupling was loose. Subsequently the coupling failed, resulting in the pressurized release of steam and hot water.

4.20 The Assistant Engineer escaped the area using the staircase to deck 1.

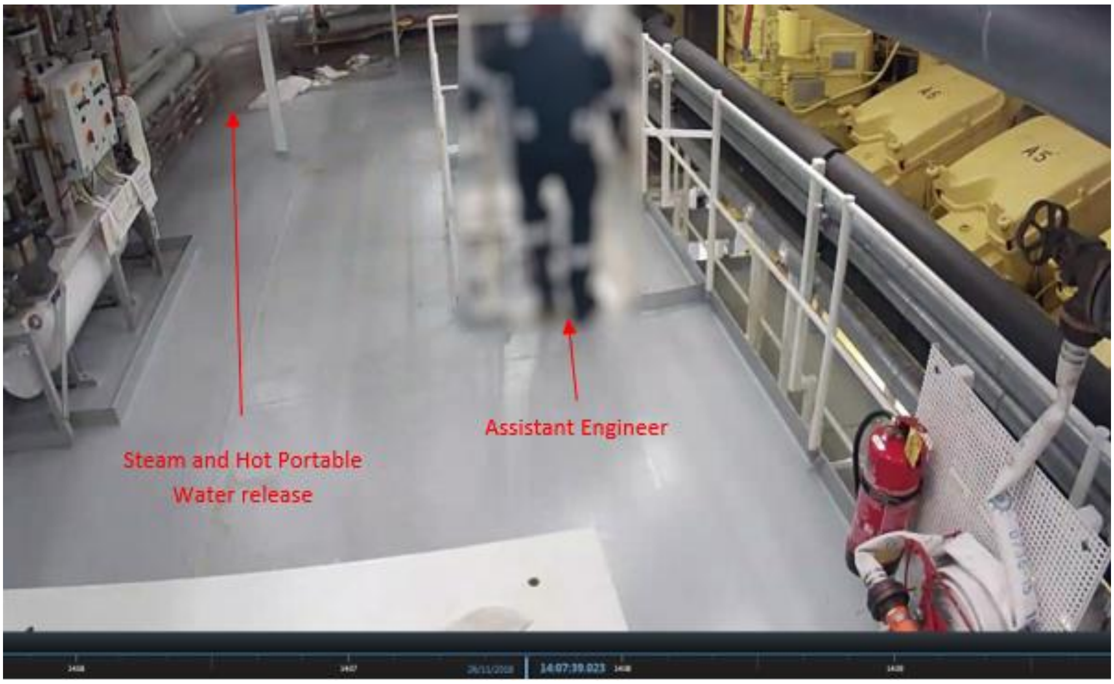

Figure 9: Deck 2 CCTV footage screenshot of location of Assistant Engineer's escape

4.21 In the immediate vicinity of the leak, located beneath the Motorman and Oiler were two access holes which provided open access for pipelines running between decks 1 and 2.

Figure 10: Location of opening access for the pipelines on deck 2-floor plate

4.22 The Motorman and Oiler escaped the vicinity of the leak via one of the two open access holes[4]. The Motorman proceeded down, onto the tank top and crawled beneath the deck plating on deck 1 and then up and onto deck 1 towards the port side of deck 1 (figure 12). The Oiler lowered himself onto deck 1 and walked towards the port side of deck 1.

[4] From the evidence available, the precise escape path of the Motorman and Oiler could not be recalled.

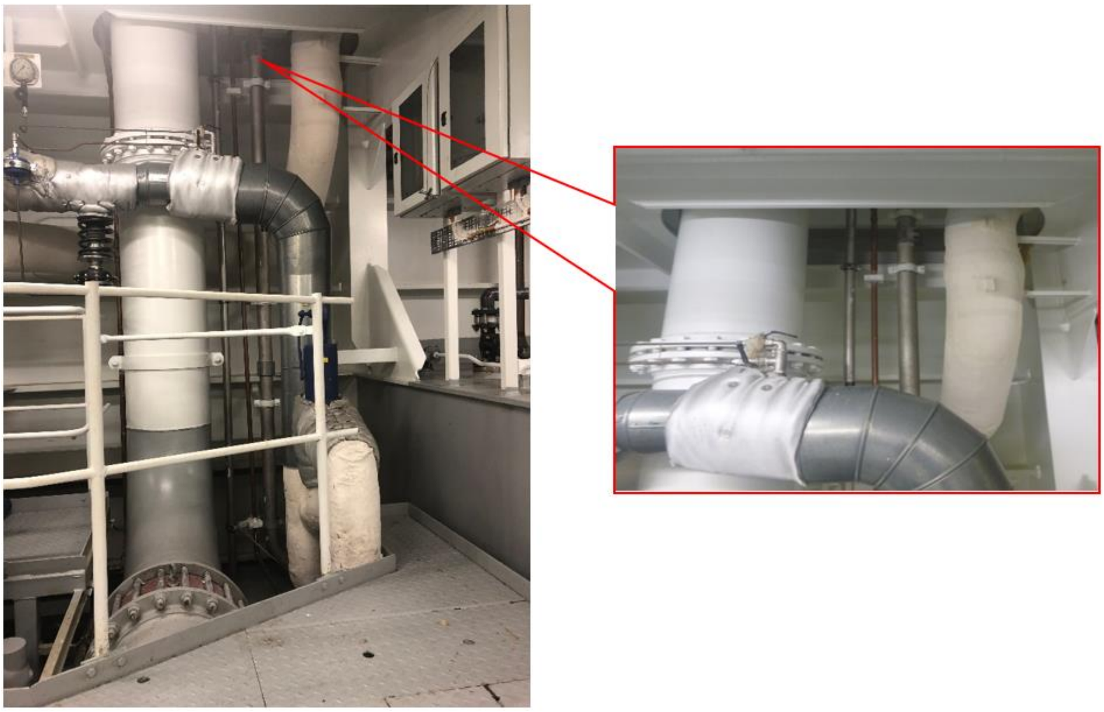

Figure 11: Location of opening access for the pipelines as seen from deck 1

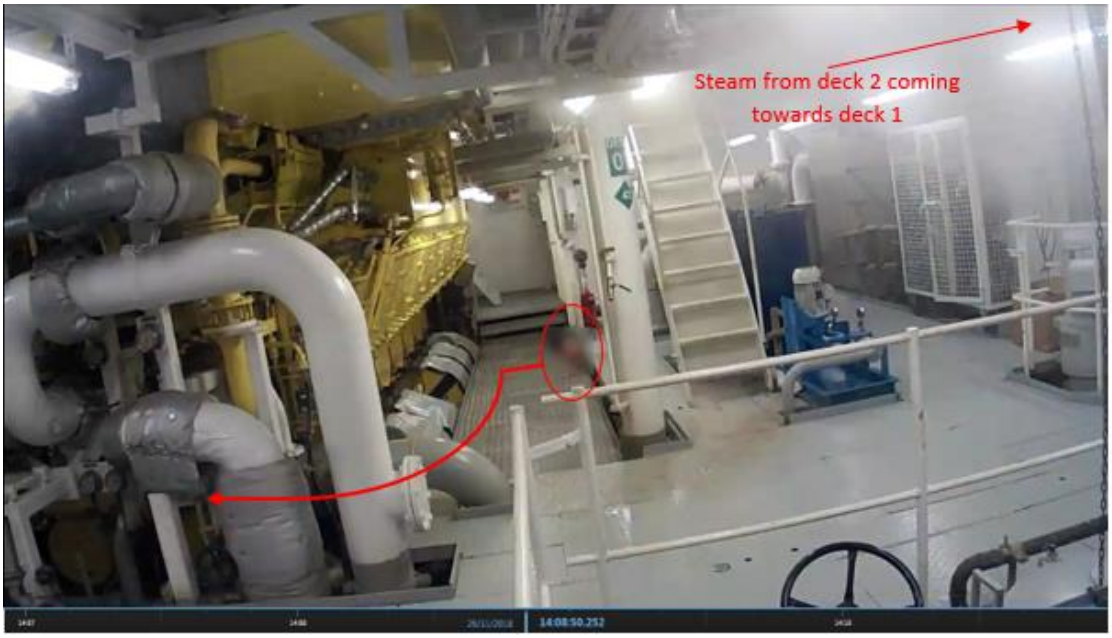

Figure 12: Deck 1 CCTV footage screenshot of Motorman's escape path on deck 1

Figure 13: Oiler's escape path

4.23 The Assistant Engineer notified the First Engineer about the incident. The First Engineer was in his office and immediately arrived at the vicinity of the incident after receiving the call. He observed that the injured personnel were lying near the generator platform on deck 1. The First Engineer then notified the Duty Engineer in the engine control room and asked him to raise a code Alpha. The Duty Engineer informed the bridge and code Alpha was raised at around 1413 hours.

4.24 A few moments later, the medical team arrived at the vicinity and the injured crew members were provided with first aid by the medical team. The injured personnel were then taken to ship's medical center.

4.25 At 1901 hours the injured personnel were medically evacuated by USCG helicopter to North Carolina Jaycee Burn Center in North Carolina, USA.

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5 ANALYSIS AND DISCUSSION

5.1 Accessibility to the vicinity of the leak

5.1.1 The leakage was observed by the Assistant Engineer from the hot potable water pipeline on deck 2, compartment 15.

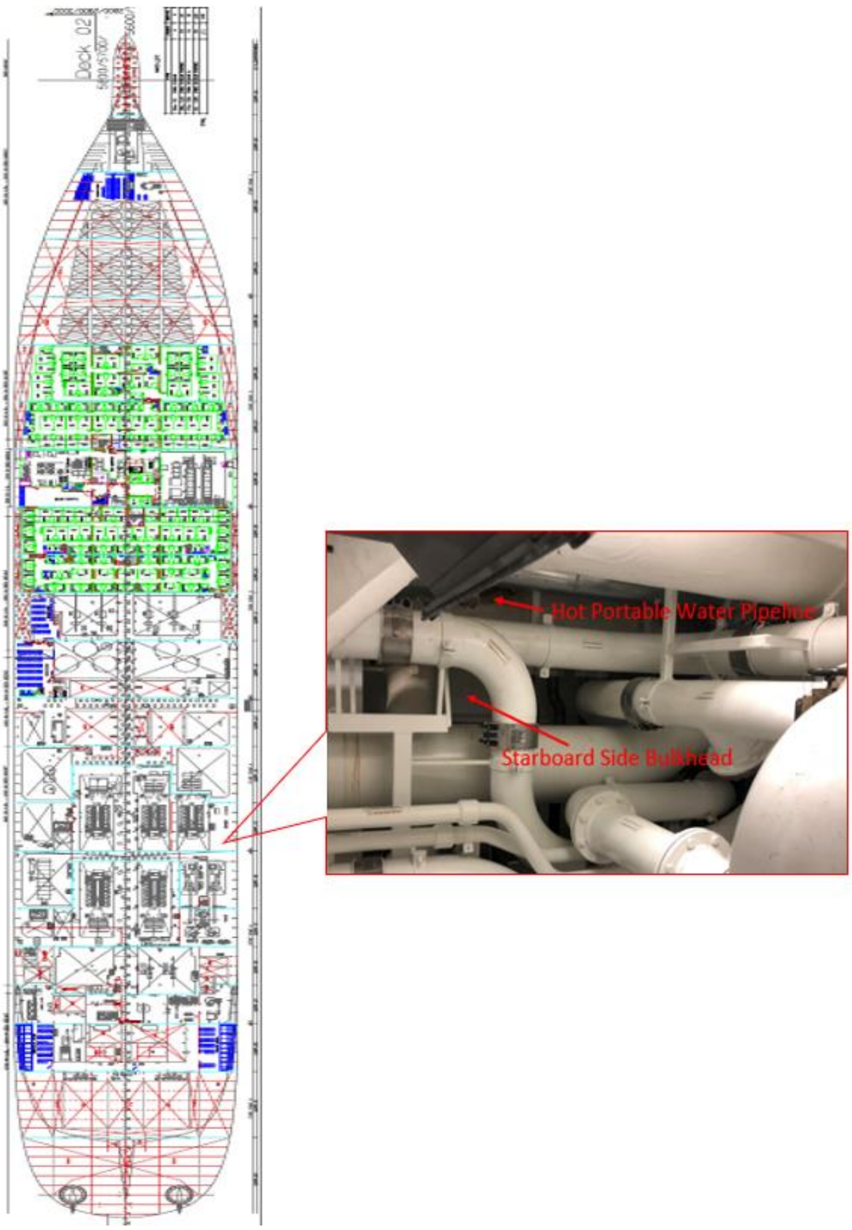

Figure 14: Location of the leak on hot potable water pipeline in deck 2, compartment 15

5.1.2 In the vicinity of the leak the hot potable water pipeline section had 2 couplings.

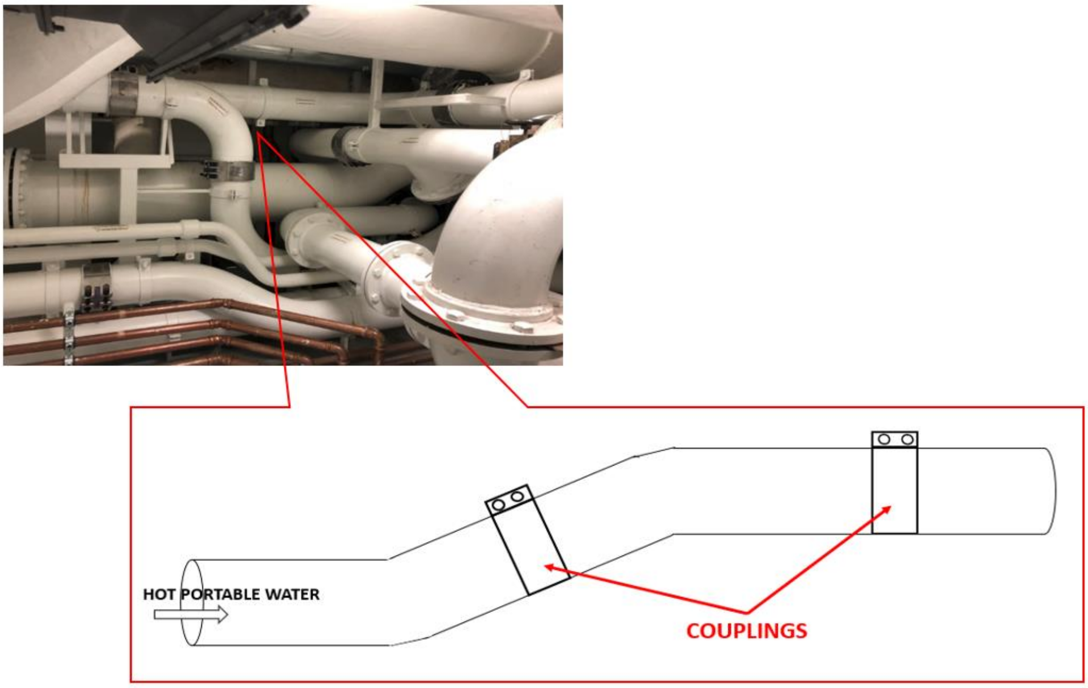

Figure 15: Location of couplings[5] on deck 2

5.1.3 The vicinity of the leak had limited access restricting one person to enter at a time. Both personnel had to climb in from the space between pipelines to access the coupling where the leak was identified.

5.1.4 At the time of the incident, due to the steam and water coming from the pipeline at a pressure of 8 to 9 bars where the coupling failed, the Oiler and Motorman were unable to escape through the same access from where they entered.

5.1.5 The deck floor in the vicinity had an opening access for the purpose of passing pipelines down to deck 1. At the time of the incident, the Oiler and Motorman utilized one of the two openings as a means of escape.

5.2 Inappropriate Hazards identification

5.2.1 The insulated pipeline where the leak was identified, supplied the hot potable water to the galley riser and aft riser. The Assistant Engineer informed the First Engineer about the leak and it was decided to conduct a non-routine operation by tightening the coupling to stop the leak, while the pipeline contained water at a pressure of 8 to 9 bars and with a temperature of around 65°C.

5.2.2 The Motorman and Oiler were tasked by the Assistant Engineer to remove the insulation material, tighten the coupling and replace with new insulation material once work activity was completed.

[5] Image is only for illustration purpose and not as per scale

5.2.3 The company's safety procedure for Onboard Risk Assessments for non-routine operations states: *Risk assessment is careful examination of what could cause harm during a job. When preparing for a new task, particpants in that task should be involved in the assessment process. A short "toolbox meeting" before starting the job can be the appropriate time to perform the assessment. Use of the Onboard Task Risk Assessment form will assist in the risk assessment*. The procedure also covers the steps for risk assessment which includes identifying the hazards associated with each step. The procedure includes the question that can be asked to identify all the hazards. These questions included: *Can someone be caught in, by, or between objects* and *is there stored energy nearby or part of the job?* Even though the work activity involved limited access to the leak and pressurized (8-9 bars) hot potable water pipeline, no risk assessment or toolbox meeting was conducted before commencing the work activity.

5.2.4 The company's safety procedure for Works Requiring Lockout and Tagout states: *the Chief Engineer/Staff Chief Engineer and personnel under his direct supervision will determine the need to isolate equipment. The equipment will then be subjected to the lockout and tagout procedures following the steps on the Works Requiring Lockout And Tagout-Checklist* (Appendix I). The Chief Engineer was not aware of the intended work activity to be conducted on the hot potable water pipeline. However, the Assistant Engineer had informed the First Engineer about the leak and it was decided by the First Engineer to tighten the coupling to stop the leak. The procedure for lockout and tagout was not considered before commencing the work activity.

5.2.5 Further the company's safety procedure for Works Requiring Lockout and Tagout also states: *Equipment normally included are: elevators, radar antennas, main and secondary switchboards, high pressure (gas and liquids) plants and system, hot temperature (gas and liquids) plants and systems, particular machineries as Azipods, propellers and rudder blades in case of divers interventions etc.* The Works Requiring Lockout and Tagout Checklist (Appendix I) consist of the quantifiable limits of high temperature as greater than or equal to 80°C. However, the procedure or checklist does not provide the quantifiable limits for high pressure. The procedure for lockout and tagout was not considered to be implemented before commencing the work activity on account of the temperature being lower than that required by the Lockout and Tagout procedure.

5.2.6 The leak was considered as a minor leak on the coupling and it was decided to tighten the coupling to stop the leackage. The hazards associated to the work activity involving the work on pipeline with hot potable water at 8 to 9 bars and with a temperature of around 65°C were not appropriatly identified.

5.3 Coupling maintenance guidelines

5.3.1 There were no guidelines or procedures available onboard, which could be followed in case of leakage from the coupling.

5.3.2 The product brochure of the coupling available on the manufacturer's website consists of the installation and dismantling instructions. The product brochure is also supplied with each box of coupling. There is no information available in the product brochure related to the guidelines to follow in case of leakage from the coupling.

5.3.3 The coupling manufacturing company was contacted by the investigators. The manufacturer informed the investigators that the installation and dismantling instructions are to be followed in case of leakage. No evidence was found to indicate that the product brochure was referred to by the crew members before commencing the work activity to rectify the leakage.

5.3.4 The tightening torque for screws can be found on the coupling label. The product brochure also provides the guidance for the required tightening torque value for screws on the coupling at the time of installation.

Figure 16: Tightening torque value for screws on coupling's label

5.3.5 Under installation guide of the product brochure it states: '*The couplings do not require any maintenance and must not be retightened once the torque has been reached. We recommend you mark the coupling once the screws have been torqued up. This will ensure that you and others know that the screws have been tightened. If you are unsure as to whether the screws have already been tightened, loosen the screws completely and repeat the installation from scratch.*' The dismantling instructions on the product brochure of the coupling also state: '*Ensure that there is no pressure in the pipes at the joint to be removed*' and '*Protect yourself and equipment from spilling liquid*'.

5.3.6 The crew members did not follow the installation guidelines by loosening the screws completely. Instead, they attempted to rectify the leaking coupling by tightening the coupling, hence changing its torque, while the pipeline was still under pressure.

5.4 Hot potable water system maintenance schedule

5.4.1 The installation guide of the product brochure states that the couplings do not require any maintenance. However, there is potential of failure of the coupling due to inappropriate installation leading to leak or deterioration of gasket over time. The vessel's maintenance schedule of the hot potable water system consists of the inspection and maintenance of the hot potable water pump, motor and the heat exchangers. No maintenance schedule was available onboard relating to the checks or inspection of the couplings on the hot potable water system in case of any failure due to inappropriate installation or deterioration of gasket.

5.4.2 From the manufacturers of the coupling it was found that that there were no on-going maintenance procedures or guidelines related to the checks or inspection schedule for the couplings.

5.5 Inappropriate PPE

5.5.1 From the CCTV footage it was observed that the Motorman and Oiler were wearing white coloured gloves while carrying the new roll of insulation material and tools to deck 2.

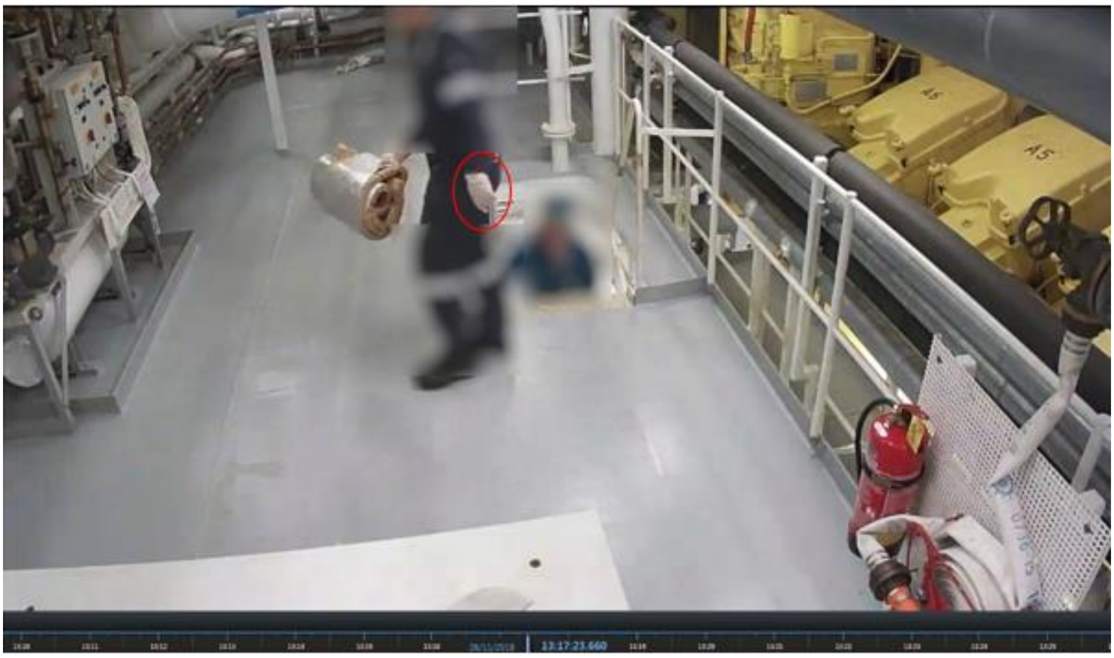

Figure 17: CCTV footage screenshot of the Oiler wearing white coloured gloves

Figure 18: CCTV footage screenshot of the Motorman wearing white colored gloves

5.5.2 After the incident the gloves were observed to be inflated, most likely due to exposure to hot water and steam. The make and type of gloves could not be identified from the evidence available.

Figure 19: CCTV footage screenshot of the inflammation of glove after the incident

5.5.3 As per the information provided by NCL, white poly-cotton type gloves and single-use vinyl disposable gloves are available onboard to the crew members. However, considering the inflammation of the gloves post-incident as seen in CCTV footage, it was observed that the crew members were using single-use vinyl disposable gloves at the time of the incident.

Figure 27: Typical sample of vinyl disposable gloves

Figure 20: Type of single-use Vinyl Disposable Gloves available onboard at the time of the incident

5.5.4 The single-use vinyl disposable gloves available onboard at the time of the incident had a maximum temperature limit of 40°C and were not appropriate to be used while working on the hot potable water system which contained water at 65°C.

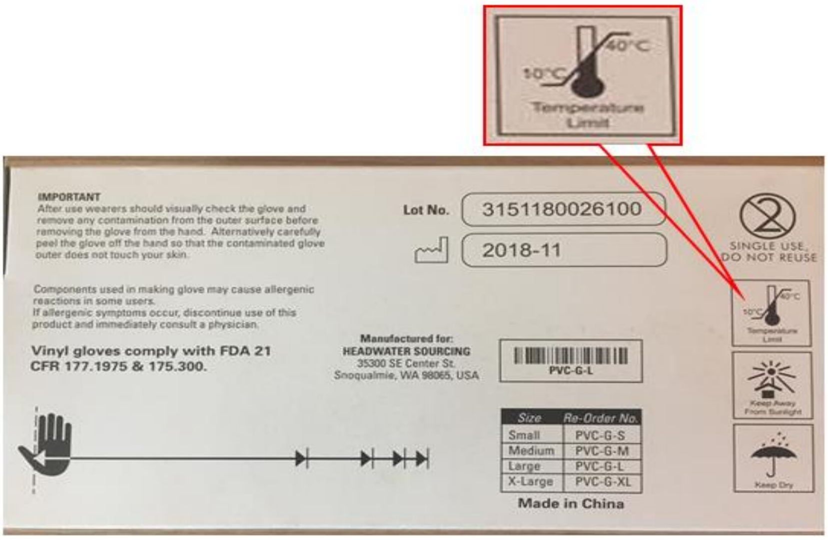

Figure 21: Operational information of the Vinyl Disposable Gloves available onboard

5.5.5 The company’s procedure for basic personal protection equipment safety requirements states: *‘General Personal Protective Equipment Requirement: Department Heads shall ensure that crew members under their direction wear the correct personal protective equipment when performing work’.* The procedure incorporates the bases on which the PPE is selected, which includes the hazards identified with particular type of work and the area of the vessel. Further, the procedure also states the requirement for hand protection: '*Crewmembers shall wear hand protection when working in areas where a hazard exists that could cause injury to hand and fingers due to skin absorption of hazardous substances, severe cuts, lacerations, abrasions, punctures or burns and temperature extremes'*. However, from the CCTV footage it was observed that the crew members were wearing the gloves which were not appropriate for the work activity involving the hot potable water system which contained water at 65°C.

5.6 Coupling and gasket failure analyses

5.6.1 LPI, Inc. (Lucius Pitkin), New York was requested by Norwegian Cruise Line (NCL) to provide independent engineering services in the evaluation of a failed pipe coupling onboard the Norwegian Escape. The purpose of the evaluation was to determine the nature, and if possible, the root cause of the failed coupling. Two couplings were provided for analysis; the failed coupling and a new coupling. The results of that analysis are detailed below.

5.6.2 Results of the analysis revealed that the submitted pipe coupling failed as a result of stress corrosion cracking (SCC) of its casing. SCC is a failure mode by which a material which is susceptible to SCC fails under the influence of exposure to a corrosive service environment and tensile stresses. Type 304 stainless steel[6] is highly susceptible to SCC in a chloride containing environment. The presence of corrosion product/deposit on the outer casing surface and Energy Dispersive X-ray Spectroscopy (EDS) analysis of this corrosion product/deposit confirmed that a chloride containing electrolyte was present during service, most likely the chlorinated water carried by the pipe system. The stress was present as residual stress from manufacture of the sheet stainless steel, installation and bending of the casing about the pin.

[6] The coupling was made of Type 304 stainless steel

Figure 22: Failed coupling as received by LPI, Inc.

5.6.3 The source of the water was likely leakage through the gasket-to-cooper pipe interface. It could not be determined if the leakage occurred as a result of a deteriorating gasket or due to faulty installation of the coupling.

5.6.4 Additionally, the second major component to the coupling was analysed by an independent external provider, Analyze Inc. Their remit was to analyse the rubber gasket of the failed coupling and were similarly provided with a new, unused gasket for comparison. The results are detailed below.

5.6.5 Examination of the gasket material performed by Analyze, Inc. indicated that hardening of the incident gasket material could have been caused by auto-oxidation promoted by the presence of copper ions. In addition, a likely leak path exhibiting some greenish/turquoise copper oxide was observed through the gasket-to-copper pipe interface. This would allow chlorinated water from the pipe system to seep through the gasket-to-copper pipe interface providing the condition to create SCC on the outer casing. However, faulty installation of the coupling could have also caused such a condition and could not be ruled out as a root cause.

Figure 23: Greenish/turquoise deposit in the center of the gasket

5.6.6 Elevated water temperature in the pipe and the presence of insulation around the pipe outer surface retaining the seeping water around the coupling further could have accelerated the SCC process.

Figure 24: Failed coupling recovered after incident

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6 CONCLUSIONS

6.1 The Assistant Engineer observed a leak around the insulated hot potable water pipeline on deck 2 in the engine room and informed the First Engineer. The Motorman and Oiler were tasked to remove the insulation material and tighten the coupling.

6.2 The work activity was particularly challenging given the location of the leak which was identified on the pressurized (8-9 bars) hot (65°C) potable water pipeline. However no risk assessment or toolbox meeting was conducted before commencing the work activity and the procedure for lockout and tagout was not implemented before commencing the work activity.

6.3 There were no guidelines or procedures available by NCL or the manufacturers on board which could be followed in case of leakage from the coupling.

6.4 It was found that there was no maintenance schedule available on board related to the checks or inspection of the couplings in case of any failure due to inappropriate installation or deterioration of gasket.

6.5 From the CCTV footage it was found that the crew members were not wearing appropriate PPE; specifically gloves which did not provide adequate protection for the specific work activity.

6.6 The labatory evaluation determined stress corrosion cracking due to exposure of chlorinated water as the cause of coupling failure. The chlorinated water source is likely to be through the gasket to pipe interface. However, it could not be determined if the leakage occurred as a result of a deteriorating gasket or due to faulty installation of the coupling.

***

7 RECOMMENDATIONS

Recommendations for the operator:

7.1 Consider providing additional training to Engineering personnel to improve the identification of hazards and conducting job-specific risk assessments.

7.2 Consider including the well-defined quantifiable limits for high pressure within Company SMS.

7.3 Consider reviewing the quantifiable limits of high temperature within Company SMS.

7.4 Consider a review of the lockout and tagout procedure to include the requirement for lockout and tagout when working on a high pressurized system as deemed necessary by job-specific risk assessment.

7.5 It is recommended to review the PPE procedure to include specific guidance for correct use of PPE for specific work activities.

7.6 It is recommended to incorporate specific guidance produced by the manufacturer within the Company procedures for the maintenance of couplings on the hot potable water system.

Recommendations for the Manufacturer:

7.7 Consider producing a specific guideline or procedure for maintenance of coupling in case of any defect or leakage.

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Appendix I:

NORWEGIAN CRUISE LINE OCEANIA CRUISES Regent SEVEN SEAS CRUISES

Rev. 00 – 09/01/2015

DEH/P003/CL2

WORKS REQUIRING LOCKOUT AND TAGOUT

PREPARATION AND RISK ANALYSIS

Equipment or System to be Locked & Tagged Out ➔				
EQUIPMENT REVIEW	**Yes**	**No**	**N/A**	**Notes**
Equipment Lockout and Tagout Steps				
1. The equipment has been shut down following normal procedures.				
2. All applicable operating controls have been identified and shut off.				
3. All applicable energy sources have been disconnected.				
4. The locks and identifying tags have been applied (for MV Switchboard equipment, the safety key interlock system has been applied).				
5. Any stored energy has been released or restrained.				
6. The Engine Control Room has been informed and the involved equipment entered in the Engine log book as relevant.				
7. The Bridge has been informed and the involved equipment entered in the Deck log book as relevant.				
Work on plants with steam / liquid under pressure or high temperature (Temp. ≥ 80°C)				
1. The Equipment Lockout and Tagout Steps listed above have been completed.				
2. Between the two sectioning valves is present a drain.				
3. Section the part of the system by means of at least two valves.				
4. Drain the interested portion by means of the lower drainage of the line before starting work.				
5. Open also the upper drainage in order to facilitate flow.				
6. Lock and tag the sectioning valves.				
7. Verify temperature of the interested component before starting work.				
Work on plants with gas / air under pressure or high temperature (Temp. ≥ 80°C)				
1. The Equipment Lockout and Tagout Steps listed above have been completed.				
2. Enough ventilation in the area involved by the work.				
3. Air monitoring during the work required.				
4. Section the part of the system by means of at least two valves.				
5. Between the two sectioning valves is present a drain.				
6. Drain the interested portion by means of the lower drainage of the line before starting work. If deemed necessary flowing gas shall be collected in relevant containers.				
7. Lock and tag the sectioning valves.				
8. Verify temperature of the interested component before starting work.				

SAFETY LOCKS DISTRIBUTION				
Name	**Position / Rank**	**Lock ID #**	**Key #**	**Installed on (valve, equipment, cabinet, etc.)**

A briefing with involved personnel has been completed: Time:

Involved Personnel	**Signature**	**Not Applicable**
Staff Captain:		
Chief Engineer:		
Chief Electro Technical Officer / Chief Electrical Engineer:		
Bridge OOW:		
Engine EOW:		
Other:		

Name and Signature of: Work Supervisor ____________________ Risk Analysis Officer____________________ Date ____________________