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**REPORT OF THE
INVESTIGATION INTO
THE FATAL INCIDENT ON-BOARD
'FV OILEÁN AN ÓIR'
AT THE PORT OF KILLYBEGS,
CO. DONEGAL
ON
24th AUGUST 2015**

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**REPORT NO. MCIB/246
(No. OF 2016)**



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	PAGE
1. SUMMARY	4
2. FACTUAL INFORMATION	5
3. NARRATIVE	9
4. ANALYSIS	14
5. CONCLUSIONS	16
6. SAFETY RECOMMENDATIONS	17
7. APPENDICES	18
8. CORRESPONDENCE RECEIVED	30

1. SUMMARY

On the 24th August 2015 the 'FV *Oileán an Óir*' was lying alongside at the Town Pier in Killybegs harbour following work on the vessel when it was out of the water. The refrigerated sea water system (RSW) had been out of service since March of 2015. Two members of the crew were assigned to run the RSW to check that it was operational. The work commenced at about 13.00 hrs. Seawater was pumped through the RSW into the port side and starboard side refrigerated sea water fish storage tanks. It was noted that the water was dirty and a decision was made to suction out both tanks using a vacuum pumping system. Following this, Crewmember 1 went into the port side RSW tank and was overcome by toxic gases. Crewmember 3 had been attending to other duties on-board, and was alerted by Crewmember 2 that Crewmember 1 was in difficulty. As Crewmember 3 raised the alarm Crewmember 2 returned to the tank and was also overcome. There were no witnesses to the incident. Crewmembers 1 and 2 were rescued from the tank and removed to hospital by the local shore-side emergency services. Crewmember 1 died later that evening and Crewmember 2 died on Friday the 28th August. Both deaths have been attributed to the inhalation of toxic gases that were present in the confines of the port side RSW tank.

Note all times are local time = UTC + 1

2. FACTUAL INFORMATION

2.1. The vessel

See Appendix 7.1 Photograph No. 1.

Name: *'FV Oileán an Óir'*.

Type of Vessel: Fishing Trawler.

Flag: Irish.

Port of Registry: Rossaveal.

IMO No: 9297462.

Call Sign: EI7573.

LOA: 27.00 metres (m).

Beam: 8.00 m.

Depth: 4.1 m.

Gross Tonnage: 252 tonnes (t).

Year: 2004.

Shipyard: Astilleros, De Pasaia, Spain.

Classification: Bureau Veritas.

Main Engine: Caterpillar 1200hp @ 1200rpm.

Deck Machinery: 3 x Split Winches/Auxiliary Winch.

3 x Split Net Drums/Gilsen Anchor Winch.

Power Block Crane/Dog Rope Winch.

Capacities: Fuel 40,000 Litres (l).

Fresh Water 5,000 l.

Three Refrigerated Sea Water (RSW) Fish Tanks 110 m³.

Information Specific to the incident: See Appendix 7.2: Drawings of the vessel.

The Port Side Refrigerated Sea Water Tank:
See Appendix 7.1: Photograph Nos. 2, 3 & 4.

Dimensions/measurements/calculations:

Length: 5.4 m.

Breadth: 2.6 m.

Depth: 3.1 m.

Depth from top of access hatch to base of tank at access ladder: 3.225 m.

Depth of scum mark on tank: 0.21 m forward 0.55 m aft.

Calculated volume of water that was pumped into the tank based on scum marks on tank sides: 4.3 m³.

Refrigerated Sea Water System (RSW):
See Appendix 7.1: Photograph No. 5.

Component Part of the RSW system - details:

Pre-cooler Evaporator Pump: Serial No. 384278.

Year 2011.

18.5 kW.

Characteristics: Output 185 m³/Hr. at 17 m head.

Condenser Pump: Serial No. 384279.

Year 2011.

5.5 kW.

Characteristics: Output 65 m³/Hr. at 16 m head.

Refrigeration Plant: Serial No. SP1364.

Year 2011.

Refrigerant K134A - 60-KGs.

The RSW piping system is stainless steel grade 316. The piping from the seawater inlet valve chest to the Pre-cooler Evaporator Pump is 200mm nominal bore. The remainder of the refrigerated system piping is 150mm nominal bore.

On the 6th November 2015 the piping was measured at Rossaveal Harbour and the following volumes were calculated. All volumes are approximate (See Appendix 7.1 Photograph No. 5).

Section A: From the sea water inlet valve chest and filter to the Pre-cooler Evaporator Pump, 190 l.

Section B: From the Pre-cooler Evaporator Pump to the valve before the filter on the main deck, 271 l.

Section C: From the valve before the filter on the main deck to the pre-cooler heat exchanger and the distribution manifolds, 574 l.

Section D: The circulating pipe work from the distribution manifolds to the suction side of the Pre-cooler Evaporator Pump, 447 l.

The total approximate volume 1,482 - litres \approx 1.5-mtr³ (1.5-tonnes).

2.2. Voyage Particulars

Not Applicable.

2.3. Marine Incident Information

Type:	Death of two crewmen due to inhalation of toxic gases.
Date:	24th August 2015.
Time:	Circa 13.30 hrs.
Position:	Killybegs Ireland.
Ship Operation:	Vessel alongside pier.
Location:	Ireland - North West Coast.
Human factors:	Not following safe practices/procedures in accordance with S.I. 325/1999 Safety Health and Welfare at Work (Fishing Vessel) Regulations, 1999 and the Safety, Health and Welfare at Work Act, 2005.

Physical factors:	Toxic gases present in the confines of the port side RSW tank. These toxic gases had been released from the water which had been in the dormant refrigerated sea water system.
Consequences:	Death of two crewmembers.
Weather:	06.00 hrs to 12.00 hrs Winds fresh to strong force 5 to 6, from south-west direction. Weather mostly dry and sunny, just a few isolated showers in the general area. The visibility was good. The air temperatures were about 13°C.
Tide at Killybegs:	24th Aug 2015 HW 00.36 2.94 m. LW 00.700 1.47 m. HW 13.30 2.95 m. LW 19.48 1.53 m

2.4. Shore Authority Involvement

Crewmembers 1 and 2 were rescued from the tank and removed to hospital by the local shore-side emergency services. Crewmember 1 died later that evening and Crewmember 2 died on Friday 28th August.

The vessel was cordoned off and isolated. The vessel was subsequently made safe and the investigation into the circumstances of the incident by law enforcement, Regulatory Authorities and the MCIB commenced circa 28th August 2015.

3. NARRATIVE

3.1. History of the vessel

- 3.1.1. Built in Spain to the owners' design, the vessel originally had two holds for the storage of the boxed fish catch. The holds were configured forward of the engine room, fore and aft. Both holds were refrigerated.
- 3.1.2. Circa 2006, the owners installed a vacuum pumping fish discharge system on the vessel so that the catch could be pumped ashore. The machinery and discharge tank for this system are mounted on the main deck forward port side and the associated piping was directed to the holds and overboard.
- 3.1.3. In 2010, the owners decided to convert the aft. hold into three individual refrigerated seawater tanks; port, middle and starboard. The design work was undertaken by a firm of naval architects and approved by the classification society, Bureau Veritas. The work on the construction of the three tanks was carried out at Killybegs in 2010. The installation was carried out under the scrutiny of, and approved by, the classification society. Due to time constraints the 3 tanks were completed in 2010 and the refrigeration system, pipework and pumps for the RSW were fitted in 2011. This latter installation work was also carried out at Killybegs under the direction and control of a combination of the owners, a specialist refrigeration company and a marine fabrication company. The refrigeration machinery and RSW distribution manifold are mounted on the main deck forward mid-ship and the associated piping is directed to the three tanks, the engine room and coupled into the vacuum pumping system. The seawater inlet valve and the adjacent filter are located in the engine room together with the two seawater pumps.
- 3.1.4. In the course of the above works the arrangement of the piping for the vacuum pumping system was altered so that fish could be discharged from the three newly formed RSW tanks.
- 3.1.5. The works were completed before the start of the 2011 pelagic fishing season. A representative of the specialist refrigeration company sailed with the vessel for a short period to attend to the hand-over of the system, deal with any operational difficulties and instruct the crew in the operation and maintenance of the system.
- 3.1.6. Not shown on the drawing of the RSW system at Appendix 7.2, is an off-take connection on the seawater supply pipe located after the pipe rises through the main deck and before the filter box on the main deck. A spigot attached to the off-take valve provides the facility for the attachment of a hose. The off-take gives the flexibility to use the pre-cooler evaporator pump for general purposes.

3.2. Events Prior to the Incident

- 3.2.1. The RSW system performed well and to specification over the fishing seasons from 2011 to 2015 with no issues of note. The regime generally adopted was that on the voyage to the fishing grounds, the middle tank was filled with seawater using the pre-cooler evaporator pump. The temperature of this water was then reduced to about 1 °C by changing over the pump suction from the sea suction to circulating the contents of the tank through the pre-cooler evaporator. This provided a ready supply of suitably refrigerated seawater on-board to preserve the catch as it was harvested (See Appendix 7.1 Photograph No. 4 of drawing of the system). The crewmembers entered the fish tanks routinely, in particular towards the end of discharging the catch when the remaining fish had to be manually directed into the suction ports of the vacuum pumping system. There were no gas monitoring instruments carried on the vessel to check the quality of the atmosphere in the RSW tanks or other confined spaces on-board.
- 3.2.2. The pelagic fishing season finished in March of 2015. The RSW system and the vacuum pumping system were flushed through with a mixture of water and detergent and then shut down. It is not known whether seawater or fresh water was used at the time.
- 3.2.3. The purpose of the flushing process is to remove residues of fish offal and fish scale deposits. The process involves circulating the water and/or detergent mix through the system for a number of hours and then discharging it overboard. After the cleaning process the RSW system was not drained and sections A, B, C and D as described in Section 2, Factual Information, remained full of water and any remaining fish offal and detergent. Between March 2015 and August 2015 the RSW system was not used.
- 3.2.4. In August 2015, the vessel was lifted out of the water using the synchro-lift at Killybegs. The principal work carried out was the overhaul of the main engine, but hull cleaning and painting were also undertaken. The vessel was placed in the water shortly after the high tide (09.42 hrs) on Thursday the 20th August 2015 and motored under its own power to the old town pier and tied-up (See Appendix 7.3: Harbour layout and access point drawing). The vessel was moored towards the end of the pier on the eastern side. The minimum depth where the vessel lay alongside is given as five metres on the drawing.
- 3.2.5. The only works carried out on the RSW system during this time was on the morning of the 20th August 2015 when some water (estimated 30 gallons ≈ 140 litres) was drained at the filter in the engine room in order to remove the pressure gauge which was positioned after the evaporator pump and to fit a plug in its place.
- 3.2.6. During the remainder of that Thursday, Friday and Saturday morning the Skipper and the three crewmembers attended to general works on the vessel. The RSW system was run on the following Monday the 24th August 2015.

3.3. The Incident

- 3.3.1. On that day the Skipper was not present on-board. Crewmembers 1 and 2 who were the more experienced members of the crew, took on the tasks in respect of the RSW system. Crewmember 3 attended to other duties and was not involved in the work.
- 3.3.2. There were no witnesses to the incident, however, it is understood that in the normal course the middle RSW tank would be filled first but this tank was open at its forward door and could not be used. Thus the port and starboard tanks were used instead (See Appendix 7.1 Photograph 5). It was decided that it was more practical to use seawater rather than fresh water to run the RSW system. The following steps would be required to fill the port and starboard tanks:
- The seawater inlet valve in the engine room would be set to open.
 - The valve on the suction side of the evaporator pump would be set to open.
 - The valves on the inlet and outlet sides of the filter on the main deck would be set to open.
 - Then the crewmembers had a choice as to whether they wanted to fill into the top of the tanks or the bottom of the tanks and would have selected the appropriate two valves at the manifold and set them to open.
 - The valves on the circulation line adjacent to the suction of the evaporator pump and the suction valves on the manifold would have been set to closed.
- 3.3.3. Once this work had been completed the evaporator pump would have been started either at the local electrical board at the refrigeration plant on the main deck or in the engine room. With the evaporator pump running, water from the harbour was pumped through the RSW system displacing the contents of the system into the RSW tanks. This meant the RSW tanks contained a mixture of harbour water and the dormant water from the RSW system (see Section 2, factual information RSW system piping sections A, B and C).
- 3.3.4. From the information available in respect of the draught of the vessel, the tidal conditions and the harbour depth as set out in harbour layout, it is calculated that the sea suction for the RSW system on the vessel was approximately five metres above the bottom of the harbour in the period leading up to the incident.
- 3.3.5. Calculations, from scum marks on the tank sides described earlier, indicate that Crewmembers 1 and 2 stopped pumping water into the port side RSW tank at about 4.3 m³ volume, when it was noted that the water in the port tank was dirty.

- 3.3.6. Crewmembers 1 and 2 then used the vacuum pumping system to suck out the “dirty” water from both the port and starboard tanks.
- 3.3.7. Crewmember 1 then went into the port side tank, possibly to remove a submersible pump that had been stored there. He was overcome by toxic gases. Crewmember 2 alerted Crewmember 3 who raised the alarm. Crewmember 2 then went to Crewmember 1 to assist him and was also overcome by the gases.

3.4. The Investigation

- 3.4.1. It was confirmed that the original refrigeration plant for the aft. hold, the piping for which passes through the port side RSW tank, was in good order and was not the source of the toxic gases.
- 3.4.2. Water samples from the RSW system and the harbour were taken for analysis. Among the samples, three were taken as set out below (See Appendix 7.1: Photograph No. 5):
- The sea suction valve in the engine room was checked to ensure it was closed.
 - The cover of the filter box after the sea suction valve was removed and a sample of the water in the filter was taken.
 - The water in the filter box housing was lifted out and dumped overboard. The water that remained in the pipework up to the main deck drained back into the filter box and it too was lifted out and dumped overboard.
- 3.4.3. When all of the water in the filter box and from the pipework to the main deck had been removed the valve on the circulation line adjacent to the suction of the evaporator pump was examined. The water from the circulation line flowed down into the filter box. A gas monitor indicated high levels of hydrogen sulphide (H₂S) were present in and emanating from the water that had been lying dormant in the circulation line. The exercise was repeated once more with similar results. Two samples of this water were taken for analysis (See Appendix 7.4: Calibration Certificate for Gas Monitor).
- 3.4.4. In the course of the investigation there were anecdotal reports of pollution from the dumping of fish in the harbour at Killybegs. It was also noted that concerns had been raised with the Harbour Master about possible pollution and the condition of the bed of the harbour at the old Town Pier. The concerns included the fact that toxic gases may have been from the remains of rotting fish on the seabed. There are anecdotal reports of some users of the Town Pier becoming ill when walking on it. It was locally believed that the cause of this was from rotting fish from the seabed close to the Town Pier. The HSA carried out further sampling at the Town Pier a number of months after the incident. The samples included the silt of the harbour bottom. The results were that only very low/background levels of hydrogen sulphide (H₂S) were present.

- 3.4.5. There had been two reported accidental fish spills at the new pier in the outer harbour where the very large trawlers berth. There were no reports of fish spills at the old Town Pier, which is mostly used for lay over and maintenance of boats.
- 3.4.6. Donegal County Council carries out monthly monitoring on the water quality at Killybegs harbour (See Appendix 7.5: Ambient monitoring records for the period of the 13th January 2015 to the 30th September 2015). These reports do not record any changes in the water quality between monitoring periods.
- 3.4.7. The Environmental Protection Agency (EPA) Ecological Monitoring & Assessment Unit carries out quarterly monitoring on the water quality at a number of locations in Killybegs harbour including the Port Inner/Market Pier. The monitoring is carried out under the EPA'S Water Framework Directive Monitoring Programme. The water samples are taken from the surface and from the bottom. It is understood that a routine quarterly monitoring was carried out in the harbour on the 26th August 2015, two days after the incident and that no adverse results were recorded (See Appendix 7.6: EPA Monitoring records 26th August 2015, close to Town Pier).
- 3.4.8. The monitoring carried out by both agencies does not include specific tests for levels of hydrogen sulphide (H₂S). The Health and Safety Authority (HSA) analysed the water samples that were taken subsequent to the incident for the presence of hydrogen sulphide (H₂S).
- 3.4.9. The results are as follows:
- Samples generally less than 10-µg/ltr.
 - Filter on main deck 870-µg/ltr.
 - Circulating line (sample taken by MCIB) 2,200-µg/ltr.
- 3.4.10. The Autopsy reports for both crewmen give the cause of death respectively as due to asphyxiation secondary to inhalation of hydrogen sulphide gas and multi-organ failure (mainly in myocardial and in the central nerve system) after intoxication of hydrogen sulphide gas transport and changing in cellular level.

4. ANALYSIS

4.1. Toxic gases are formed by the breaking down of organic materials such as fish. In this instance the gases hydrogen sulphide (H_2S) and Ammonia (NH_3) formed and were held in solution in water. The source of lethal levels of hydrogen sulphide (H_2S) and elevated levels of ammonia (NH_3) could be generated either by the seawater from the harbour or dormant water that existed in the RSW system. The results of monitoring and sampling by the various bodies and interested parties indicate that the source was not from the harbour water. When the emergency services measured the level of hydrogen sulphide levels of 178 parts per million and ammonia levels of 18-parts per million it was a short while after the incident and the hatch on port side RSW tank was open to atmosphere. Thus it can be assumed that the levels of toxic gases in the tank at the time of the incident were above this level.

The effect on humans of hydrogen sulphide is as follows-at:

- 100-150 ppm the olfactory nerve is paralyzed after a few inhalations, and the sense of smell disappears, often together with awareness of danger.
- 320-530 ppm leads to pulmonary oedema with the possibility of death.

4.2. The most salient finding in regard to the source of the contamination was the high level of toxicity found when the water contained in the circulating line that was released to the atmosphere on the 4th September 2015 as described above. The reason being that when Crewmembers 1 and 2 set up the RSW system to pump water into the port and starboard side RSW tanks there would have been no necessity for them to open the valve on the circulation line adjacent to the suction of the evaporator pump or the suction valves on the manifold. The circulating line is only brought into service at a later stage in the process as described in Section 3.2 above. Thus there would have been no movement of fluid in the circulating line pipework (See Factual Information, pipework Section D) in the period leading up to the incident and it would have contained the same residual water (447 l) after the incident as it had contained before the incident. This water would have been of the same age as the dormant water that existed in the RSW system (See Factual Information, pipework Section C) which was pushed ahead of and displaced by the sea water that was pumped through the RSW system and into the tanks. Thus it follows that there is a direct correlation in the levels of contamination between the quality of the water in pipe Section C and pipe Section D.

4.3. The volume of water that was pumped into the tank, calculated to be approximately 4.3 tonnes (4,300 l), was a mixture of seawater from the harbour and the dormant water that existed in the RSW system, calculated to be approximately 574 l, (See Factual Information, Section C). The toxic gases were contained in the water that was pumped into the port side RSW tank by Crewmembers 1 and 2. Once the water was agitated by the pumping in of seawater, the toxic gases were released from the dormant water into the atmosphere in the tank. The water was then pumped out of the tank using the vacuum pumping system but the toxic gases remained in the atmosphere in the tank.

- 4.4. The death of both crewmembers was caused by the inhalation of lethal levels of hydrogen sulphide (H₂S) accompanied by elevated levels of ammonia (NH₃) that were present in the atmosphere in the port side RSW tank, as measured by the emergency services.
- 4.5. It was routine on-board the vessel for the crew to enter all three RSW tanks when they were both in-service for their intended purpose and out-of-service for possible storage purposes. Therefore it is possible that Crewmember 1 had no hesitation in entering the port side RSW tank and would not have perceived the danger that this action posed to him or the repercussions to the safety of Crewmember 2.
- 4.6. It is noted that in the merchant shipping sector that fatalities due to enclosed space entry is an issue of considerable concern. In this regard the International Maritime Organisation issued an amendment to the SOLAS convention addressing the issue, which became effective from the 1st of January 2015. Following on from this the main port state control regimes carried out a concentrated inspection campaign on enclosed space entry in the autumn of 2015. Ireland as a member state of the Paris Memorandum of Understanding (Paris MoU) took part in this concentrated inspection campaign (CIC). The preliminary results of this CIC have been published by the Paris MoU in February 2016 (See Appendix 7.7: Preliminary results of CIC) and as can be seen the issue continues to be of concern.
- 4.7. Familiarity with enclosed space entry continues to be an issue in the merchant shipping sector which would be considered to have more awareness and development in this area than in the fishing vessel sector. Specifically, as the SOLAS convention does not apply to fishing vessels, the new regulations do not apply to fishing vessels.
- 4.8. The Department of Transport, Tourism and Sport has previously published guidance in this area for all vessels including fishing vessels in Marine Notice No. 24 of 2009 - Off gassing of Carbon Monoxide, Carbon Dioxide and hydrogen sulphide from certain cargoes (See Appendix 7.8: Marine Notice).
- 4.9. Whilst the SOLAS convention in relation to enclosed space entry does not apply to fishing vessels, the Safety, Health and Welfare at Work Act, 2005 requires all employers including self-employed persons, to have a Safety Statement which identifies all hazards and assesses the risks on the fishing vessel, which is a place of work. The Act also sets out the duties of employers and employees in respect of practices and procedures in a place of work. In addition S.I. 325/1999 the Safety, Health and Welfare at Work (Fishing Vessels) Regulations 1999 also apply and cover safety on-board, including duties and responsibilities in respect of vessel construction, and training and instruction to ensure safe practices and procedures.

5. CONCLUSIONS

- 5.1. The death of both crewmembers was caused by the inhalation of lethal levels of hydrogen sulphide (H_2S) accompanied by elevated levels of ammonia (NH_3) that were present in the atmosphere in the port side RSW tank. Crewmember 1 entered the port side RSW tank and was immediately overcome by toxic gas. Crewmember 2 attempted to assist Crewmember 1 and also became overcome by toxic gas
- 5.2. Neither the vessel, nor the crewmen had equipment to monitor the atmospheres within the tanks. The duties of employers and employees found in the Safety, Health and Welfare at Work Act, 2005 and S.I. 325/1999 the Safety, Health and Welfare at Work (Fishing Vessels) Regulations 1999 apply to fishing vessels as a place of work.
- 5.3. The source of lethal levels of hydrogen sulphide (H_2S) and elevated levels of ammonia (NH_3) was the dormant water that existed in the RSW system Section C.
- 5.4. The hazards associated with the generation of toxic gases from the decaying of organic matter and the consequent hazard that these toxic gases and or the depletion of oxygen in the atmospheres in confined spaces is well known in the broader marine industry. The understanding and recognition of the dangers associated with these toxic gases does not appear to be as well known within the fishing industry. International developments and increasing awareness of issues with the dangers of enclosed space entry in vessels indicate that there is need for greater awareness and guidance in this regard specifically for fishing vessels.

6. SAFETY RECOMMENDATIONS

- 6.1. It is recommended that the Minister for Transport, Tourism and Sport issue a Marine Notice warning crews on fishing vessels of the hazards associated with toxic gas generation and retention in RSW systems and that a notice highlighting these dangers be displayed on vessels fitted with RSW systems. It is recommended that the Marine Notice may include details on enclosed space entry techniques, raising awareness of calibrated atmospheric monitoring systems, either permanent or hand held and rescue techniques.
- 6.2. It is recommended that the Minister for Transport, Tourism and Sport considers mechanisms to address the safety in respect of design, construction and operation of RSW systems and the generation of toxic gases as in this case.

	PAGE
7. APPENDICES	
7.1. Photographs	19
7.2. Drawings of the Vessel	22
7.3. Harbour Layout Drawing	23
7.4. Gas Monitor Calibration Certificate	24
7.5. Ambient Monitoring Records	25
7.6. EPA Monitoring Records	26
7.7. Preliminary results of CIC	27
7.8. Marine Notice No. 24/2009	28

Appendix 7.1 Photographs.



Photograph No. 1: - 'FV Oileán an Óir'.

Appendix 7.1 Photographs.



Photograph No. 2: Port Side Refrigerated Sea Water Tank.

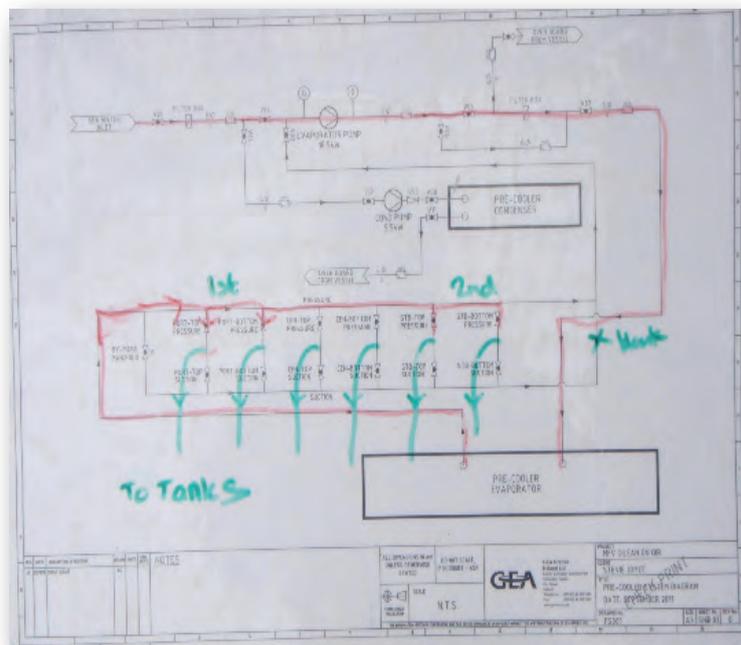


Photograph No. 3: Port Side Refrigerated Sea Water Tank.

Appendix 7.1 Photographs.



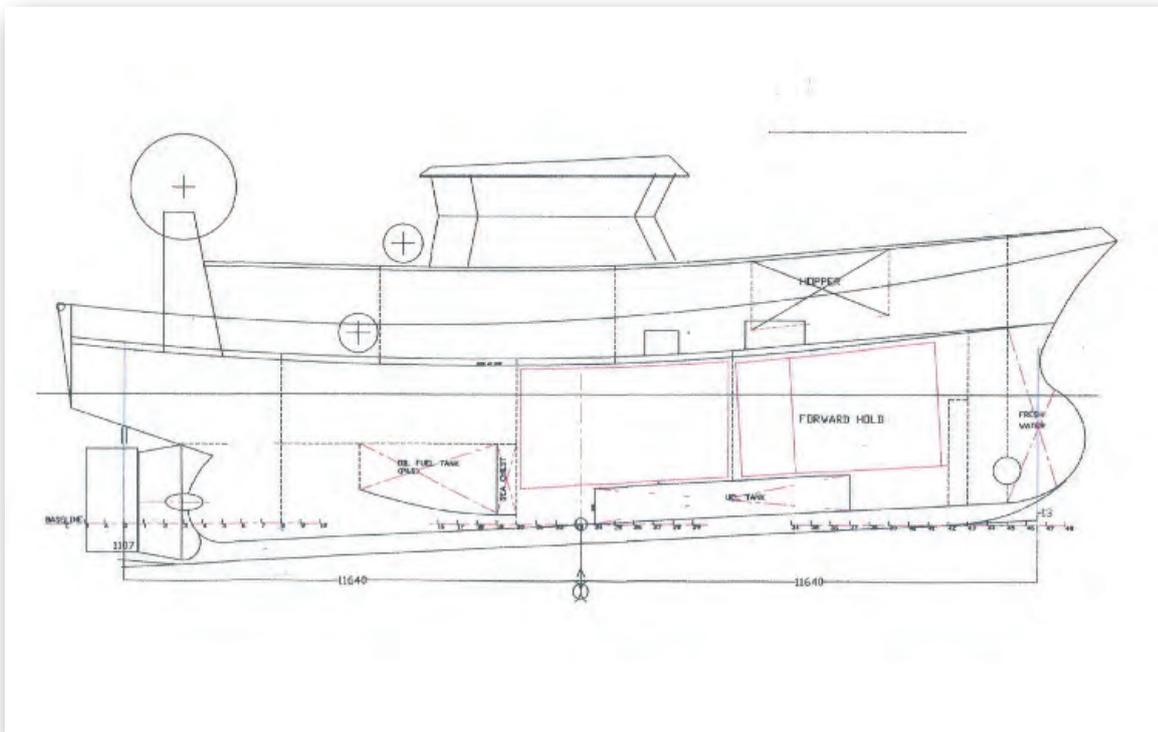
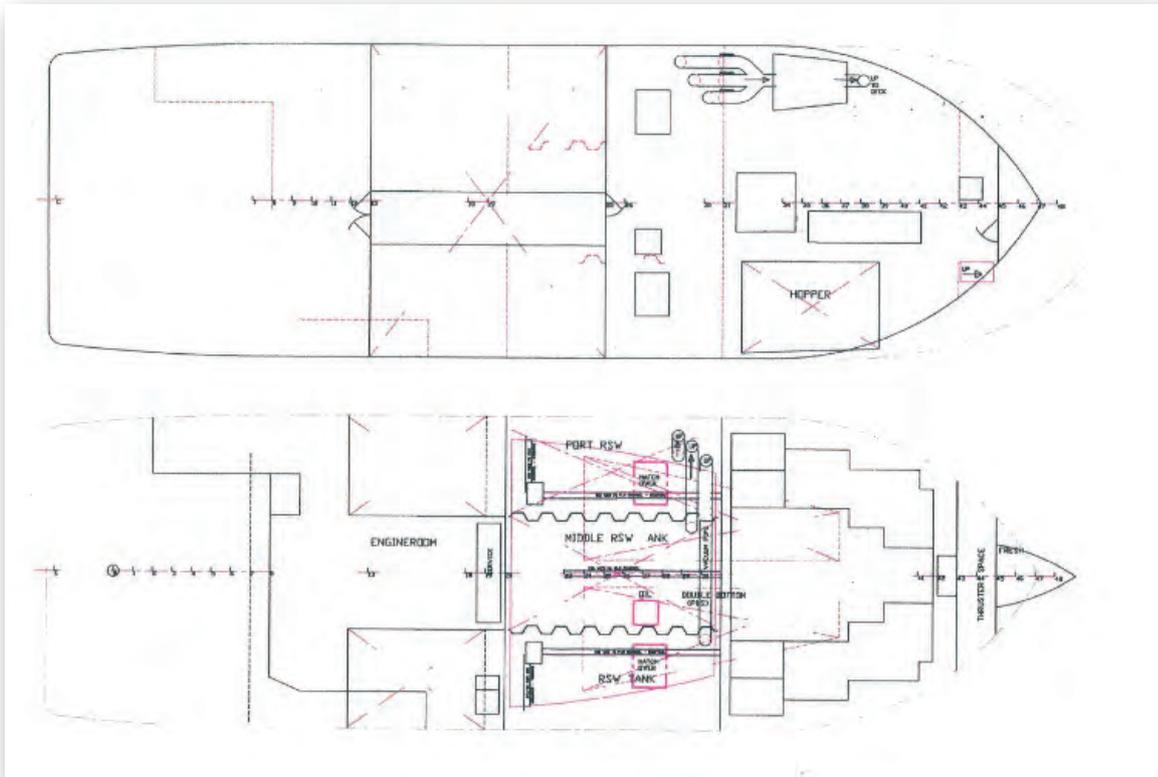
Photograph No. 4: Port Side Refrigerated Sea Water Tank.



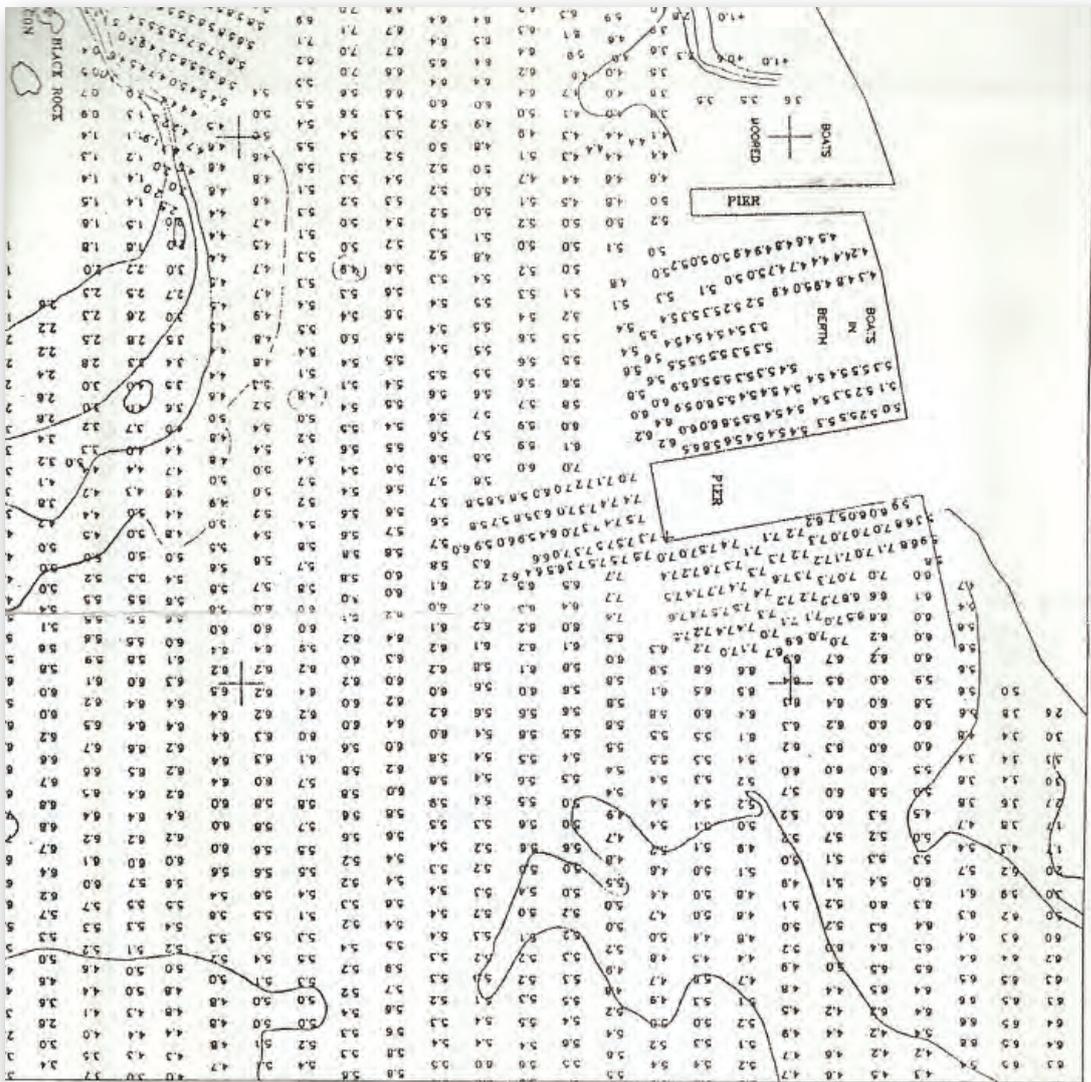
Photograph No. 5: Refrigerated Sea Water System.

APPENDIX 7.2

Appendix 7.2 Drawings of Vessel 'FV Oileán an Óir'.



Appendix 7.3 Harbour layout and access point drawing.



REV	DESCRIPTION	DRAN DAT
DRAWN BY NHH	CHECKED BY YOL	APPROVED
DATE 16/04/99	DATE 16/4/99	DATE
BASE DRAWING SCALE 1:1250		SCHEDULE SHEETS
CLIENT DEPARTMENT OF THE MAR AND NATURAL RESOURCE		
PROJECT KILLYBEGS FISHERY HARBOUR REFURBISHMENT OF PILES LANDING PIER AND BLACKROC		
TITLE HARBOUR LAYOUT AND ACCESS POINTS		
 KIRK McCLOSURE MORTON CONSULTING ENGINEERS TEL: 01232 667914 FLUMBERG LANE FAX:		

Appendix 7.4 Gas Monitor Calibration Certificate.



Instrument Calibration Certificate

Customer: Respro Ltd.

Location: 78 D Lagan Road,
Glasnevin,
Dublin 11.

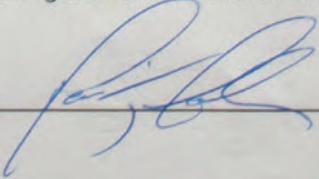
Instrument Type: Draeger Xam 5000.

Serial Number: ARCB - 0722.

Calibration Date: 3rd September 2015.

	Sensor 1	Sensor 2	Sensor 3	Sensor 4
Sensor	CH4	O2	H2S	CO
Type	CAT Ex	EC	EC	EC
Range	100 %LEL	25 Vol%	200 PPM	2000 PPM
Alarm 1	10 %LEL	19 Vol%	5 PPM	20 PPM
Alarm 2	20 %LEL	23 Vol%	10 PPM	100 PPM
Calibration Gas	CH4	O2	H2S	CO
Concentration	57 %LEL	18.0 Vol%	15 PPM	50 PPM
LOT No.	1768311	1768311	1768311	1768311
Zero Before	0.0 %LEL	N/A	0.0 PPM	0.0 PPM
Zero After	0.0 %LEL	N/A	0.0 PPM	0.0 PPM
Span Before	54.0 %LEL	17.9 Vol%	14.0 PPM	51.0 PPM
Span After	57.0 %LEL	18.0 Vol%	15.0 PPM	50.0 PPM

This certificate confirms that the calibration of this instrument was checked by a Respro Engineer and found to be within the manufacturer's specifications.

Signed:  on behalf of Respro Ltd.

Re-Calibration Due: 3rd March 2016.

78D Lagan Road,
Glasnevin, Dublin 11.
Tel: (01) 830 7551
Fax: (01) 830 4115
Email: info@respro.ie

Appendix 7.5 Ambient monitoring records for the period of the 13th January 2015 to 30th September 2015.

Location	Lab. Ref	Date	T C	BOD (mg/l)	DO	DH (mg/l)	Chlorophyll (mg/m ³)	Ortho P (mg/l)	Faecal Coliforms cfu/100mls	Escherichia Coli cfu/100mls	enterococci cfu/100mls	Visual Inspection	Metal and Organic Compounds
Killybegs													
aSWB-1 Inner Harbour 1													
aSWB-1	152501026	13/01/2015	6.7	1.85	8.34	0.018	6.471	0.032	104	12	96	Nothing Observed	NT
ASWB-1	152501380	17/02/2015	7.5	5.91	7.71	0.984	29.87	1.326	NT	NT	NT	Sewer discharge	NT
ASWS-1	152501951	24/03/2015	8.5	40.38	9.84	0.73	56.148	<0.01	1.2x10 ⁴	1200	470	Sewer Discharge/boat discharge	NT
ASWB-1	152502337	28/04/2015	9.4	<1	6.39	0.691	13.836	<0.01	NT	NT	NT	Nothing Observed	NT
ASWB-1	152502564	21/05/2015	11.2	<1	11.25	0.077	11.009	0.047	NT	NT	NT	Nothing Observed	NT
ASWB-1	152502913	11/06/2015	14.3	1.73	10.5	0.028	6.857	<0.01	68	1	156	Nothing Observed	NT
ASWB-1	152503360	16/07/2015	16	3.81	10.11	0.829	15.02	0.144	NT	NT	NT	Nothing Observed	NT
ASWB-2	152504030	19/08/2015	17	2.91	10.12	0.215	15.147	<0.01	NT	NT	NT	Nothing Observed	NT
ASWB-1	152504634	30/09/2015	14	25.96	6.77	2.254	67.223	1.219	5.2x10 ⁴	3.0 x 10 ⁴	1.7x10 ⁴	Sewer Discharge/boat discharge	NT
aSWB-2 Inner Harbour 2													
aSWB-2	152501027	13/01/2015	6.7	1.64	8.81	0.06	5.244	0.026	234	106	384	Nothing Observed	NT
ASWB-2	152501381	17/02/2015	7.4	5.77	8.12	0.462	32.45	0.59	NT	NT	NT	Sewer discharge	NT
ASWB-2	152501952	24/03/2015	8.4	3.37	6.45	0.63	31.899	<0.01	1.9x10 ³	1700	350	Nothing Observed	NT
ASWB-2	152502338	28/04/2015	9.4	<1	6.86	0.593	12.583	<0.01	NT	NT	NT	Nothing Observed	NT
ASWB-2	152502565	21/05/2015	11.2	1.02	11.3	0.063	8.913	<0.01	NT	NT	NT	Nothing Observed	NT
ASWB-2	152502914	11/06/2015	14.2	1.04	10.52	0.03	4.951	0.01	12	6	18	Nothing Observed	NT
ASWB-2	152503361	16/07/2015	16.5	6.2	9.09	1.073	19.913	0.195	NT	NT	NT	Sewer discharge	NT
ASWB-2	152504031	19/08/2015	16.7	1.52	9.83	<0.010	18.698	<0.01	NT	NT	NT	Nothing Observed	NT
ASWB-2	152504635	30/09/2015	13.5	3.72	8.42	0.487	15.216	0.263	4.7x10 ⁴	2.3x10 ⁴	4.5x10 ⁴	Nothing Observed	NT
NGR:													
aSWB-1	171772E	375751N											
aSWB-2	171760E	375693N											

APPENDIX 7.6

Appendix 7.6 EPA Monitoring records 26th August 2015.

DO_saturation %Sat	pH	NH3 mg/L N	NH3_LOD	TON mg/L N	TON_LOD	PO4 µg/L P	PO4_LOD	BOD mg/L O ₂	BOD_LOD	Chl_a mg/m ³	Chl_a_LOD	Chl_a_est_LOD	Corrected_Si µg/L Si	TOC	Lab	Lab_No
74	8	0.074		0.00499	<0.010	19		0.4999	<1.0	0.999	<2	<200	99.999	2	EPA Monaghan	1513193
92	7.1	0.019		0.031		8		1.2		0.999	<2		1100	16	EPA Monaghan	1513192
74	8	0.038		0.00499	<0.010	16				0.999	<2	<200	99.999		EPA Monaghan	1513195
92	7.8	0.02		0.034		8.7				0.999	<2		780		EPA Monaghan	1513194
74	8	0.022		0.015		8.9		0.4999	<1.0	0.999	<2		250	6	EPA Monaghan	1513197
85	7.9	0.021		0.022		8.5		1.2		0.999	<2		580		EPA Monaghan	1513196
74	8.1	0.025		0.00499	<0.010	12				0.999	<2	<200	99.999		EPA Monaghan	1513199
94	7.7	0.017		0.034		8.6				0.999	<2		810		EPA Monaghan	1513198
81	8.1	0.04		0.00499	<0.010	14						<200	99.999		EPA Monaghan	1513211
96	8	0.013		0.042		9.6		1.2		0.999	<2		470	8	EPA Monaghan	1513210
71	8.1	0.02		0.00499	<0.010	9.1				0.999	<2	<200	99.999		EPA Monaghan	1513213
99	8	0.012		0.02		6.2				4			470		EPA Monaghan	1513212
81	8.1	0.032		0.00499	<0.010	11		0.4999	<1.0	2		<200	99.999	2	EPA Monaghan	1513215
97	7.7	0.00499	<0.010	0.024		5		1.2		0.999	<2		810	14	EPA Monaghan	1513214
87	8.1	0.014		0.00499	<0.010	5.1				0.999	<2	<200	99.999		EPA Monaghan	1513217
97	7.9	0.00499	<0.010	0.023		2.499	<5			0.999	<2		780		EPA Monaghan	1513216

Appendix 7.7 Press release preliminary results on enclosed space entry.



Appendix 7.8 Marine Notice No. 24 of 2009.



Department of Transport
An Roinn Iompair



Marine Notice No. 24 of 2009

*NOTICE TO ALL SHIPOWNERS, FISHING VESSEL OWNERS, AGENTS, SHIPMASTERS,
STEVEDORES, SKIPPERS, FISHERMEN AND SEAFARERS*

Off-gassing of Carbon Monoxide, Carbon Dioxide and Hydrogen Sulphide from certain cargoes

The Department of Transport would like to advise that a series of fatal accidents on board ships in Western Europe and other parts of the world have occurred recently on vessels presumed to be carrying safe cargoes:

- Two fishermen were killed when entering the hold of a fishing vessel that contained rotten fish;
- A seafarer was killed, a stevedore seriously injured and a number of other personnel were injured, including rescue personnel, when they entered an access stairwell to a hold that had previously contained wood pellets;
- Two seafarers were killed when they entered the hold of a vessel carrying timber logs.

These accidents occurred due to the presence of, respectively, **hydrogen sulphide (H₂S)**, **carbon monoxide (CO)** and **carbon dioxide (CO₂)** in the holds or hold access passageways and stairwells.

These gases are a product of auto-oxidation in wood pellets and the microbiological breakdown of the cargo material with regard to fish, wood-chips and pulpwood. Such processes are noted to accelerate where high ambient temperatures are experienced during the loading or carriage of the cargo. Ventilation of the holds for the purpose of dispersing such gases during the sea passage is not recommended as this may lead, by the introduction of oxygen into the air, to the spontaneous combustion of the cargo.

As a general principle, suffocating or toxic gases **should be presumed to be present** in an enclosed space that contains, or has recently contained, organic material.

Holds or adjacent confined spaces should not be entered until the atmosphere has first been tested and analysed.

Measurement of oxygen content alone should not be taken as indicating a safe atmosphere. For example, carbon monoxide and hydrogen sulphide may be present in toxic quantities in atmospheres that contain normal atmospheric oxygen content.

Appendix 7.8 Marine Notice No. 24 of 2009.

Personal atmospheric measurement devices should be capable of measuring not only oxygen content but also commonly occurring toxic and suffocating gases including, as a minimum, hydrogen sulphide and carbon monoxide. Such equipment should be carefully maintained, regularly tested and re-calibrated by competent technicians.

Presence of toxic gases have been detected in other "safe" cargoes, e.g. soya flour, paper-plastic pellets, peat pellets etc.

The Bulk Cargo Code should be consulted for information on all bulk cargoes, not only prior to loading, but also by stevedores and port operations before a vessel is discharged.

Entry into an enclosed or unventilated space should only take place after the space has been tested and proven to be free from toxic or suffocating gases.

Director General,
Maritime Safety Directorate,
Department of Transport,
Leeson Lane,
Dublin 2.

20 May 2009

For any technical assistance in relation to this Marine Notice please contact
The Marine Survey Office, Leeson Lane, Dublin 2, tel: +353 1 678 3400
For information in relation to technical specification/type approval of radio equipment
contact the Radio Surveyors, tel: +353 1 678 2363/2364/2365/2367.
For general enquiries please contact the Maritime Safety Division tel: +353-1-678 3418
Any enquiries concerning Marine Notices should be addressed to:
Maritime Safety Directorate, Department of Transport, Leeson Lane, Dublin 2
email: marinenotices@transport.ie or visit us at: www.transport.ie

8. CORRESPONDENCE RECEIVED

	PAGE
8.1. Correspondence from Harbour Master and MCIB response	31
8.2. Correspondence from Donegal County Council and MCIB response	32
8.3. Correspondence from Bureau Veritas and MCIB response	33
8.4. Correspondence from Crewmember and MCIB response	34
8.5. Correspondence from Director of Oileán An Óir Ltd and MCIB response	35

Note: The names and contact details of the individual respondents have been obscured for privacy reasons.

Correspondence 8.1 Harbour Master and MCIB response.



CORRESPONDENCE 8.2

Correspondence 8.2 Donegal County Council and MCIB response.

 **Comhairle Contae Dhún na nGall**
Donegal County Council

Oifig an Phríomh-Fheidhmeannaigh
Office of the Chief Executive
www.ccdhunnangall.ie www.donegalcoco.ie

11th July 2016

██████████
Chairman
Maritime Casualty Investigation Board
Leeson Lane
Dublin 2

Re: Draft Report of the Investigation into the fatal incident on-board "FV Oileán an Óir" at the port of Killybegs, Co. Donegal on 24th August 2015.

Dear ██████████

Thank you for sending on the above draft report.

I wish to confirm that I have noted the contents of the draft report and have no comments or observations to make in relation to same.

Yours sincerely,

██████████



Cuir freagra chuig: Áras an Chontae, Leifear, Contae Dhún na nGall, Éire | Please reply to: County House, Lifford, Co. Donegal, Ireland
Guthán/Tel: 074 9172202 | Facs/Fax: 074 9172812 | Ríomhphost/Email: sneely@donegalcoco.ie

MCIB RESPONSE:
The MCIB notes the contents of this correspondence.

Correspondence 8.3 Bureau Veritas and MCIB response.



MCIB RESPONSE:
The MCIB notes the contents of this correspondence.

CORRESPONDENCE 8.4

Correspondence 8.4 Crewmember and MCIB response

[REDACTED]

M.C.I.B.
Lesson Lane,
Dublin 2.
14th July, 2016

Draft report into fatal incident on-board 'FV Oilean An Oir' at Killybegs harbour, Co. Donegal, 24 August 2015

Dear [REDACTED]

I've read the draft report into this incident and I've noted that there is a few things that need to be changed.

In the summary, it says the crew 2 went into the tank before raising the alarm that crew 1 was in trouble. This should read Crew 2 saw Crew 1 in trouble called for Crew 3. Crew 3 called emergency services while Crew 2 proceeded into tank and was overcome by fumes. Crew 3 did not know extent of injuries or nature of distress until he saw Both Crew 1 and 2 on bottom of tank.

The narrative section 3.3.7 reads the same and in my view this should be changed to correspond with the summary.

If you have any further questions or quires don't hesitated to ring me on [REDACTED]

Regards
[REDACTED]



MCIB RESPONSE:
The MCIB notes the contents of this correspondence and has made the necessary amendments.

Correspondence 8.5 Director of Oileán An Óir Limited and MCIB response.

Private and Confidential

Secretariat,
Marine Casualty Investigation Board,
Leeson Lane,
Dublin 2

Your Ref:MCIB/12/246

02 July 2016

Re: Draft Report of the Investigation into the fatal incident on board the 'FV Oilean an Oir' at the port of Killybegs, County Donegal on the 24th of August 2015

Dear Madam,

I wish to confirm that I am a Director of the owner Company, Oilean An Oir Limited.

I am writing in relation to the Draft report as furnished to me by letter dated the 14th of June 2016.

I would propose to go through the matter in chronological order. I would like to make a preliminary point which underscores the basis for the majority of the observations I would like to make on behalf of my Client.

The Draft Report makes reference to the absence of gas monitoring equipment. In the context of a report such as this, the manner in which the references take place to this equipment being absent, is pejorative when it is a well-established fact that it is not the norm for such equipment to be present when vessels such as this are cleaning their fish tanks. In 2015, no vessel with RSW tanks had such equipment on board or deployed such equipment when cleaning fish tanks.

Factual inaccuracies within the report

A number of facts as stated within the Draft Report are wrong:

1. The GT of the vessel is not 404 tonnes, it is in fact 252 GT's.
2. The Shipyard where the vessel was built is not Astrilleros in Zamakona but rather Astrilleros in De Pasafia, Spain.
3. The fuel capacity is not 53,000 litres, but rather 40,000 litres.
4. Fresh water capacity is not 9,700 litres, but rather is 5,000 litres.
5. At Paragraph 3.1.2 it states that the vacuum pump was fitted in 2009, it was fitted in 2006.
6. Paragraph 3.1.6 is not accurate. There are in fact two valves. 1 take off valve and on submersible pump. The flexible hose referred too, is not connected to the off take

MCIB RESPONSE:
The MCIB notes points 1-5 and has amended the report accordingly.

MCIB RESPONSE:
The MCIB notes this comment and has amended the report at 3.1.6.

Correspondence 8.5 Director of Oileán An Óir Limited and MCIB response.

valve, it is connected to the submersible pump. This pump is used to take off excess water when fish are being pumped into the fish tanks. The off take has never been used.

- 7. At paragraph 3.2.2 it states that it is not known whether freshwater or seawater was used. That is not correct. Salt water was used.
- 8. 4.3 the take off valve has never been used and was not used in the shutdown procedure. Nor was it used in the months between March 2015 and the time of the incident.

I will now deal with the report in order in terms of comments and observations we would like to make:

2.3 *'Human factors: Not following safe practises/procedures'*. It is not clear how this finding is borne out by the contents of the Draft Report.

The Draft Report states that it is common practise that the crew would go into the fish tanks.

The Draft Report highlights how SOLAS does not apply to fishing vessels.

The Draft Report highlights how there has been legislation on the Merchant side of the fleet but not the fishing side of the fleet.

There was no obligation to have gas monitoring equipment on board and the crew were experienced. There was/is no suggestion of recklessness and the Draft Report does not at any stage high light any deficiency that could be categorised as the description above as contained within the Draft Report.

It would appear that there are a lot of elements within the Draft report that would lead to the Draft Report making several recommendations as to what would constitute safe practices and procedures into the future, but the Draft Report cannot criticise the events of the 24th of August 2015 as being a failure to comply with such procedures and practices when the Draft Report clearly highlights that much of what the two crewmembers did was in fact standard and normal practise.

The description under the heading of Human factors must be re-considered. It is not a reasonable statement to make in the circumstances.

3.2.1 – the Draft report states *'there was no gas monitoring instruments carried on the vessel to check the quality of the atmosphere in the RSW tanks or other confined spaces on board'*. It should be made clear that there was no requirement in law to have such equipment and that the lack of such gas monitoring equipment is a feature of the industry.

3.3.1 – *'On that day the skipper was no present on board'*. The report ought to be clear that this is in no way a criticism of the Skipper and it should be clear that it was not a requirement of the Skipper to stay in light of the experienced crew.

4.2 It is accepted that there was no need for the crew to operate the circulation line at the time that the incident occurred. It is doubtful that they did in fact, use the circulation line. If one examines picture 2 in the Draft report it is clear from the scum lines, that the inlet valve for

MCIB RESPONSE:
This was the information provided at the time of the investigation.

MCIB RESPONSE:
The MCIB notes this comment and has removed paragraph 4.3.

MCIB RESPONSE:
The MCIB notes these comments and has included the Safety Health and Welfare at Work (Fishing Vessel) Regulations 1999 in Section 4.9 of the report.

These regulations impose a duty on owners of fishing vessels to ensure safety at work on their fishing vessels.

MCIB RESPONSE:
Please see comment above.

MCIB RESPONSE:
The MCIB notes this comment.

MCIB RESPONSE:
The investigation confirmed that the major contamination was located within the circulation line.

Correspondence 8.5 Director of Oileán An Óir Limited and MCIB response.

the circulation line was not fully covered, in which case no water would have been sucked into the circulation line, just air.

4.7 – the report references a report at annex 7.7 but it is unfair not to draw attention to the fact that the date of this report was the 22nd of February 2016. This should be done within the body of the Report.

5.2 – *Neither the vessel, nor the crewmen had equipment to monitor the atmospheres within the tanks*.

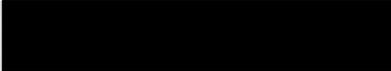
It should be made clear in the report that there was no obligation to have such equipment and that within the industry such equipment was not used at the time. It is certainly acceptable that a recommendation be made that all vessels, in particular vessels with RSW tanks, would have such equipment and use such equipment in Fish Tanks and other confined spaces.

It cannot be left as it currently is phrased as it clearly intimates a criticism of the operation of the vessel.

As you can imagine this incident was an appalling tragedy for the Company and the people who work on this vessel. One of the crewmembers was a relative of mine and it is very important that the report is as accurate and as fair as possible. We are very conscious that this report will be in the public domain.

I look forward to hearing from you in due course.

Yours faithfully,


 Director
 Oilean an Oir Limited

MCIB RESPONSE:
 The MCIB notes this comment and has amended the report accordingly, now paragraph 4.6.

MCIB RESPONSE:
 Please see comment at 2.3 above.

