

Peterhead

18 December 2006

Sheriff Ritchie

Act: ,

Alt: ,

**UNDER THE FATAL ACCIDENTS AND SUDDEN DEATHS INQUIRY
(SCOTLAND) ACT 1976**

SHERIFFDOM OF GRAMPIAN HIGHLANDS AND ISLANDS AT PETERHEAD

Determination by Sheriff Norman Ritchie, QC

in the cause

Fatal Accident Inquiry into the death of
SHAUN KING McDONALD

18th December 2006

The sheriff, having resumed consideration of the cause, determines:

1. That in terms of section 6(1)(a) of the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act 1976 Mr Shaun King McDonald died in an accident within the engine room of the M.V. Far Service at the north breakwater of Peterhead Harbour on 7th July 2002.
2. That in terms of section 6(1)(b) of the Act the cause of death, as certified, was death in an industrial fire and the accident resulting in death was caused by the spillage from a disconnected suction hose of a quantity of base oil which came into contact with components of the starboard engine or other machinery of the vessel, formed a combustible vapour and ignited.

3. That in terms of section 6(1)(c) of the Act the reasonable precautions by which the accident and the death of Mr McDonald might have been avoided are as follows:

- (a) that a proper risk assessment would have identified the danger of a spillage of base oil from a long pipe made up of a series of connected short hoses and the consequent danger of ignition;
- (b) that all machinery, including the ship's engines, should have been shut down to remove any possible source of ignition of the base oil in the event of a spillage;
- (c) that a person carrying out work in a base oil tank should have been accompanied at all times and should have been supervised by a watchman to warn of any emergency;
- (d) that such a watchman should have had the means of radio communication with the others involved in the operation on the quayside and with the ship's officers on the bridge;
- (e) that any emergency equipment, such as emergency escape kits, should have been available where the work was being done and where that equipment might be needed in the event of an emergency;
- (f) that a toolbox talk and a walk through of the work site should have identified the alternative ways to exit the engine room;
- (g) that there should have been a standardised method of installation and operation of the valves on the Tanker and the open and closed positions of the valves should have been clearly marked and signed.

4. That in terms of section 6(1)(d) of the Act the defects in the system of working which contributed to the death or the accident were:

- (a) the failure to take the reasonable precautions as above;
and more particularly
- (b) the failure of the Permit to Work system to ensure a full and proper risk assessment was done and in particular to identify the dangers of removing base oil through a working engine room and the need to shut down all equipment and

machinery which might provide a source of ignition in the event of a spill of the base oil;

- (c) the failure to communicate a copy of the Permit to Work to the charterer to advise of the nature and the progress of the work and to coordinate that work with any of the ship's other operations;
- (d) the failure to have the valves on the Tanker operating in a standard fashion and to have the open and closed positions clearly marked;
- (e) the failure to have proper training to ensure the safe operation of the valves and other equipment;
- (f) the absence of a colleague working with the deceased in the tank;
- (g) the absence of a watchman or lookout at the hatch to the tank to raise the alarm in the event of an emergency;
- (h) the absence of a means of communication between those below deck and those on the ship's bridge or on the quay;
- (i) the use of a length of flexible hose consisting of a series of short hoses which could be disconnected manually;
- (j) the absence of a clear structure of command and responsibility.

This inquiry took place at Peterhead Sheriff Court on 23rd, 24th, 25th and 26th May and on 26th, 27th, 28th and 29th September 2006. The Crown was represented by Mr Hutchison, Procurator Fiscal. Grampian Fire and Rescue Services were represented by Mrs Faulkner, Farstad Shipping Ltd by Mr Craig, Enviroco Ltd, by Miss Bowen, and Asco Plc by Mr Leith.

At the outset I wish to express my condolences to the widow, family and friends of Mr Shaun King McDonald for his death in what were the most tragic of circumstances. The family were not separately represented at the Inquiry although their interests were safeguarded by Mr Hutchison. I am grateful to all parties for their assistance. However, as almost all of the evidence was adduced by the Crown perhaps I can be allowed to commend the careful, thorough and fair way in which Mr Hutchison approached this task.

The purpose of an Inquiry such as this is to enable findings to be made within the framework of the 1976 Act. It is a fact finding exercise rather than a fault finding one. While it may form no part of the legal purpose of this Inquiry or be properly a part of my formal determination I understand the concerns the family have on the question of Mr McDonald's ability and opportunity to survive this accident. I shall address that issue as best as I can in due course.

It was clear from all of the evidence in this case how the accident occurred and there was little, if any, controversy or dispute amongst the parties about the circumstances of Mr McDonald's death.

NOTE

The M.V. Far Service is owned and operated by Farstad Shipping Ltd. It is based at Peterhead and is used to service offshore platforms and rigs in the North Sea. In July 2002 the vessel was chartered by Asco Plc. The M.V. Far Service is a vessel with a main external cargo deck and below that on the second deck level there are internal tanks used for storage of cargo such as mud, fuel oil, base oil and other substances. The engine room is situated below the main cargo deck of the ship and is divided into upper and lower levels. Access can be gained from the main deck to the engine room in two ways. Direct access is through the engine room door on the main deck and down a flight of steps which terminate at a platform at the forward end of the upper engine room. This allows access to the main floor and walkways of the upper engine room. The alternative means of access from the cargo deck is through the accommodation area down to the control room from where there is access to the upper engine room either direct or through the adjacent workroom.

On the evening of Saturday 6 July 2002 an employee of Asco Plc contacted William Buchan the charge hand for the tank cleaning team employed by Enviroco Ltd to arrange for cleaning work to be carried out on the tanks of the M.V. Far Service. Phone calls were made by Mr Buchan to mobilise the members of the team. In the early hours of the morning of Sunday 7 July the M.V. Far Service was heading to Peterhead harbour. It arrived at berth No 15 at the north

breakwater at 05.24 hours. On docking the main engines were stopped and the auxiliary generators were started to provide power for the ship's services.

The Enviroco tank cleaning team met early on the Sunday morning at the bothy at the south base with a view to arriving at the ship at about 06.00 hours. The members of that team were William Buchan, Joseph Chessser, Darren Adams, Ian McDonald, Billy Swails and the deceased Shaun King McDonald. Shaun McDonald was one of the more recent members of a team which had worked together for several years. The members of the team were very experienced in tank cleaning. Most of their training had been on the job although some of them had attended brief courses on working in confined spaces.

At about 06.30 hours the team arrived at the quayside alongside the M.V. Far Service. The team had a lorry containing the necessary equipment, a Turbo Vac lorry and a Tanker. Mr Buchan went on board to obtain the Permit to Work from the First Officer, Russell Collins. In addition to that Mr Buchan had the responsibility to inspect the tanks to be cleaned and to take the essential gas readings. While he attended to these matters the rest of the team prepared to carry out their work and by practice and routine they were able to do so without supervision or instruction.

The Permit to Work was issued by Russell Collins as First Officer of the vessel M.V. Far Service on behalf of the ship's owners Farstad Shipping Ltd to William Buchan on behalf of Enviroco Ltd. There is no indication of date or time on the Permit to Work. The Permit deals with four separate issues. Three sections relating to "Hot Work", "Electrical and Machinery" and "Work Aloft or Above Sea" have all been scored out. That last deletion to Work Aloft etc. was self evidently correct. However, although it was contemplated that work would be done in an area where there was machinery in operation it was considered that the work itself was neither hot nor to be carried out on live electrical equipment or machinery. It was not contemplated by Mr Collins or Mr Buchan that there was any danger in carrying out oil removal through an area where machinery was in operation. The sole completed section on the Permit relates to "Tank Entry" and this confirms that the rescue and resuscitation equipment was tested and available, that there had been a hazard assessment, that the gas tests

had been carried out, that access and lighting were adequate, that communications were established and that the agitators in the mud tanks had been isolated. Proper communication could not be said to have been established and the hazard of taking a length of hose through an engine room was not identified. The time of the start of the work is not recorded but it was some time shortly after 06.30 hours.

In order to extract the substances from the tanks, in this case mud and base oil (which is a constituent of drilling mud), vacuum extraction equipment mounted on a lorry was used. This device is known as a Turbo Vac. Four mud tanks were first emptied. Having extracted the mud by using the Turbo Vac and a linked Tanker, the Tanker had to be emptied and cleaned before the base oil could be put in. Shaun McDonald was responsible for cleaning the interior of the tanker with a jet hose. Then the team turned to deal with the base oil tank as the Surveyor had concluded that the base oil, which was estimated to amount to a maximum of approximately 4800 litres, could be salvaged.

On the quayside the Turbo Vac lorry was connected to the Tanker by means of a short hose connected between the inlet valves on both the Turbo Vac and the Tanker. That was done by Billy Swails as part of his role as the Tanker driver. When running the Turbo Vac or vacuum pump built up and maintained a vacuum within the Tanker. A long flexible hose (comprising five flexible rubber hoses each 100mm in diameter and thirty feet in length) was used to connect the Tanker to the base oil tank. Bauer couplings were used to join the hose sections and to connect the hoses to the valves on the Turbo Vac and the Tanker. That type of coupling is generally regarded as being the appropriate method of connecting such hoses as it allows rapid coupling without tools. The long hose went from the outlet valve of the Tanker across the quay and on to the deck of the M.V. Far Service, through a hatch and down a flight of stairs to the engine room, along the upper engine room walkway and then through a smaller hatch into the base oil tank. At the end of the hose was a length of plastic pipe which was manipulated by one of the tank cleaning crew to ensure that all the base oil was extracted around the stanchions or baffles at the bottom of the tank. The

task of removing the base oil started at about 07.30 hours but again that time is not recorded.

The valves on the Turbo Vac and the Tanker were operated with manual levers and when those levers were pointing down vertically the valves were shut. The levers on these two vehicles, as on the other tankers operated by Enviroco, were designed to work in that way to prevent the valves from opening in transit. However this Tanker was different from the others in that the valves were mounted directly on to a flange on the bottom of the tank itself and a right angled pipe was connected to the valve with a horizontal section of pipe pointing to the rear of the vehicle. The manual levers were fitted by the manufacturer on the vertical section of the pipe and not on the horizontal section as on other tankers in the Enviroco fleet. However, all of the levers worked in the same way in that the downward or vertical position as on other tankers in the Enviroco fleet. However, all of the levers worked in the same way in that the downward or vertical position closed the valves. The difficulty which arose in relation to this particular Tanker is that when the valves were closed the vertical levers were parallel to that vertical section of the pipe to which they were attached and that was contrary to the normal setup. The convention is that when a lever is parallel to a pipe, that is in line with the flow through the pipe, it signifies that the valve is open. If the lever is at right angles to a pipe, that is across the flow, it usually signifies that the valve is closed. In relation to this Tanker it is possible, therefore, to become confused as to whether the valve is open or closed when the lever is in the vertical position. Neither of these two valves carried any sign or indication as to which was the inlet valve and which was the outlet valve. There was no visible or remaining mark to indicate the open and closed positions of the valves on the Tanker. If such marks had been placed there by the manufacturer, as was suggested, then they have been hidden or erased when the tanker was repainted.

At about 07.45 hours Asco Plc informed the Master of the vessel, Captain Thomas Grimes that the M.V. Far Service was to be ready to move at about 08.30 hours to transport a heavy load from the north breakwater to the south breakwater. The engines required to be warmed up for at least 30 minutes and

they were started at around 07.50 hours. The time was not recorded and there was some uncertainty in the evidence about precisely when the engines were started again but the most accurate estimate was to be found in the statement given by Captain Grimes. The evidence of the Chief Engineer, Mr Robert Kirby, supported that estimate and in addition confirmed that the hoses used by the tank cleaning team were lying along the walkway in the engine room when the engines were running. There was no thought given to any possible hazard in starting the engines while the base oil was being removed.

The work had progressed in a satisfactory manner. Access to the base oil tank had been gained through the hatch from the level of the engine room walkway and by descending a ladder into the tank. The oil removal was carried out by Joseph Chesser and Ian McDonald. As the task was nearing completion Shaun McDonald came down the ladder into the tank. Shaun McDonald did that on his own initiative in order to assist in any way he could. Ian McDonald and Joseph Chesser then climbed out of the tank leaving Shaun McDonald there.

In the course of this operation Billy Swails was approached by James Bain, an employee of Asco Plc. Mr Bain advised him that there was a crane with a wide load which was to be taken along the quay but that the Turbo Vac was in the way. He asked Billy Swails to move the Turbo Vac vehicle. Billy Swails was aware that the operation was nearing completion but rather than wait he closed the outlet valve on the Tanker and the inlet valve on the Turbo Vac knowing that when he touched the clutch of the Turbo Vac to move the vehicle the vacuum pump would stop. The closure of the outlet valve of the Tanker would prevent fuel returning along the hose. Billy Swails had no concerns about stopping the vacuum pump without advising his colleagues. He suggested it was not unusual for the suction suddenly to stop for whatever reason. His colleagues would become aware that the hose was not drawing up the liquid and would investigate what was wrong. Billy Swails climbed into the cab of the Turbo Vac intending to move it a short distance of 20 feet to allow access by the crane. He did not disconnect the hose between the Turbo Vac and the Tanker as the 40 feet long hose was sufficient to allow that manoeuvre. He depressed the clutch and the vacuum pump stopped.

At that point William Buchan signalled from the main deck to Darren Adams on the quayside that the job was finished. Mr Buchan intended that the Turbo Vac be switched off. The signal from Mr Buchan was also seen by Mr Swails in the cab of the Turbo Vac. Billy Swails had no reason to restart the Turbo Vac again as there was no need for any further suction operation. At the same time Ian McDonald went on to the main deck of the ship and shouted to the members of the team on the quayside and made a signal across his throat that the job was finished. He saw Darren Adams on the quay. Ian McDonald expected that Darren Adams would shut off the outlet valve of the Tanker. Mr Ian McDonald then went back from the main deck down into the engine room in order to dismantle and remove the hoses as the job was completed. The ribbed construction of the hoses meant that on occasion it was difficult to pull a hose through a hatch and up out of a tank. In order to accomplish this Shaun McDonald had remained in the tank to push the hose out.

Mr Adams had been employed as a tank cleaner by Enviroco for about 18 months immediately before the accident and during that time had carried out a variety of jobs as a member of the tank cleaning team. He had operated the Turbo Vac on a few occasions but he had received no formal training and he had learned by watching what his colleagues did. He had never previously operated the valves on the Tanker. However, on seeing the signal from Mr Buchan that the job was completed he moved the lever on the outlet valve. Mr Adams himself was frank in his evidence that he had moved the lever of the outlet valve to the horizontal position when he received the signal from Mr Buchan that the job was finished and as Mr Swails he had stopped the Turbo Vac. He now understood that he had in fact reopened the valve. He had experience of other tankers where the configuration of the valves was different and even when he gave his evidence he was still confused about the correct position of the lever when the valve was open. By moving the lever from what he had wrongly assumed to be the open position in order to close the valve he had inadvertently opened the valve again. This had the effect of breaking the vacuum and allowed the base oil to flow back down the hosepipe.

Mr Swails got out of the Turbo Vac cab and walked to the rear of the Tanker in order to disconnect the hoses from the valves there. He found that Darren Adams was at the back of the Tanker. Mr Swails found that the lever on the outlet valve was not in the same position as he had left it and that the outlet valve was open. When Mr Swails saw the position of the lever he immediately rectified the situation by closing the outlet valve. Mr Swails was a little hesitant in his evidence on this matter appearing reluctant to pass on responsibility to another but he eventually confirmed that Darren Adams had admitted to him that he had touched the lever.

It was understood by the members of the team working below deck that the work was completed and that the members of the team on the quayside knew that. Mr Ian McDonald returned from the main deck as Joseph Chesser opened the Bauer clips on the last section of hose. The Second Engineer, Mr Keith Carson, was in the vicinity as Mr Chesser did that. As the coupling was undone a quantity of base oil started to flow back down the hose from the Tanker. It was obvious to Mr Chesser from that flow and the lack of sound that the vacuum was no longer operating. Mr Chesser was accustomed to dealing with a little spillage of perhaps a few litres which would be ragged up. On this occasion there was no small spill but a substantial and continuous flow which prevented Mr Chesser from reconnecting the hose despite his best efforts. The base oil spilled over the walkway deck and down toward machinery and the ship's starboard engine. That engine was running and was hot. There was an enormous sheet of flames instantly from behind the starboard engine followed by massive clouds of thick black smoke. Within a few seconds there was little visibility. The fire alarm went off automatically and that is recorded at 08.28 hours. A siren sounded, the main lights extinguished and the emergency lights came on. There were also flashing warning lights.

The evidence was neither clear nor consistent about how long the outlet valve on the Tanker was open. Mr Adams could not say for how long it was open but he recollected that the valve was closed by Billy Swails after shouts of alarm came from the deck of the M.V. Far Service and that took just under a minute. On the other hand Mr Swails recalled that it was between 30 and 60 seconds after

he closed the valve again that he heard a brouhaha (his words) on deck and saw smoke billowing from the hatch on the main deck. It was immediately obvious that something had gone wrong.

Having seen the flames Mr Carson, the Second Engineer, ran to the control room to raise the alarm. A call was made to the emergency services. The Captain phoned down to the control room because the fire sensor had gone off and he had seen the fire in the engine room on the closed-circuit television system. The Chief Engineer stopped the engines and briefly opened the door from the control room to the engine room to be met with an inferno. He manages to close the door again but the control room started filling with smoke and the Chief Engineer decided to abandon it. Escape was only possible from the control room through the accommodation area on to the main deck. As the Chief Engineer and the Second Engineer escaped on to the main deck the hatch through which the hose went into the engine room was still open and a large quantity of black smoke was emerging. It had taken the two men between one and two minutes to escape. Mr Carson closed the fire flaps to cut off the supply of air to the engine room while the Chief Engineer telephoned the bridge and asked the Captain to make sure the engine fans had been stopped.

At the same time as Mr Carson ran to the control room Mr Chesser and Mr Ian McDonald had escaped up the stairs from the engine room on to the main deck. Their escape route had taken them away from the entrance to the tank where Shaun McDonald was. Neither man had an opportunity to warn Shaun McDonald about the spillage of the base oil. They relied on him hearing the alarms and seeing the emergency and warning lights. When Mr Ian McDonald and Mr Chesser escaped onto the main deck the ship's crew were already alerted.

In the meantime Mr Swails and Mr Adams had gone to their vehicle to get the emergency breathing apparatus and took the two sets on to the main deck of the M.V. Far Service. That took one or two minutes. The First Officer, Russell Collins, was in charge of the efforts of the crew to contain the fire. A check was made of who was present and it was established that Mr Shaun McDonald and a member of the crew were not accounted for. The fire was clearly worsening and there was more smoke coming through the door from the engine room. At some

point Mr Ian McDonald put on one of the emergency sets which had been brought from the vehicle and he attempted to re-enter the engine room in a brave effort to find and rescue Shaun McDonald. He was prevented from doing so by a member of the ship's crew. The crewman was correct in that action as the emergency set was inadequate for a rescue attempt in the conditions of such a fierce fire. This type of emergency set has only about ten minutes oxygen and is simply intended to aid an escape from a fire or other emergency is not intended to be used to re-enter a danger area in a rescue attempt of this kind. Had Mr McDonald been allowed to go into the engine room he would certainly have perished. As was observed by all of the witnesses although this attempt was extremely brave there was no prospect of success.

Smoke continued to pour from the engine room through the hatch and flames could be seen. The paint on the deck and on the ship's superstructure was bubbling and the wooden deck was buckling. There was also smoke emerging from vents on the boat's superstructure. The ship's crew acted with commendable speed and efficiency to do what they could to deal with the fire before the arrival of the Fire Brigade. There was no criticism at all of the response of the ship's crew to this emergency. The First Officer was concerned that the whole ship would catch fire or even explode and after discussion the Chief Engineer, who had the responsibility, decided that the hatch be closed. That was standard fire fighting practice to prevent oxygen fuelling the fire. Members of the crew were only able to approach the hatch on their hands and knees because of the intense heat. A section of the hose was disconnected with some difficulty and the end of the hose was thrown back through the hatch down the stairs on to the first level off the engine room. The lighting cable used by the team was cut and thrown in. There were flames visible within the engine room at this point and thick black smoke out was continuing to pour out. The hatch was closed and secured. There was no information about where Mr McDonald might be other than where he was last known to have been working. The hope was that he had managed to escape from the engine room by another route as the missing member of the ship's crew had done.

In the circumstances of this emergency it is difficult to calculate with any precision how long the hatch remained open after the fire started. Mr Chesser's recollection was that the hatch was closed minutes rather than seconds after the fire started and possibly up to five minutes after. This estimate is broadly supported by the description of events given by the others who were there. When the hatch to the engine room was closed up several members of the ship's crew had put on fire fighting suits. The engine room hatch was opened briefly to assess the fire and to contemplate a further rescue mission this time by the better equipped crew. A decision was made that it was too dangerous and that no one could be alive in the engine room in the conditions.

An emergency call had been made to the fire services. The call is timed at 08.28 hours and the first fire appliance was mobilized at 08.31 hours and the first appliance arrived at the harbour at 08.35 hours. Stewart George Wood, an experienced fire-fighter with the Grampian Fire and Rescue Service, was in the first appliance and he took command of the situation on his arrival. He met with the ship's First Officer. At that time members of the crew were hosing water on to the wooden main deck to prevent an escalation of the fire. The heat was such that as soon as they turned away from an area it was dry again.

Mr Wood's immediate priority was to get teams of fire fighters wearing breathing apparatus into the engine room. Mr Wood obtained the ships plans but found them very confusing because of the excessive detail. However, Mr Wood was satisfied that he had obtained enough accurate information from the crew to enable him to send in fire fighting teams without delay. In particular, he was told that there was a missing man who was thought to be in the area of the base oil tank in the engine compartment. There was no question at all of obtaining access to the engine room from the hatch on the main deck. He was advised of the alternative means of access through the control room to the workroom and from there to the engine room. That route was necessary because the door between the control room and the engine room could not be opened as the door had warped badly because of the heat. It was thought that a temperature of about 600°C was needed to cause that damage to a steel door.

The first team to enter through the control room laid down a fire hose and was followed by another team into the engine room. The engine room was filled with smoke so thick that the fire crews could barely see in front of them. Judging distance in those conditions was extremely difficult. The heat was intense. The crews were wearing breathing apparatus and the normal fire fighter's uniform. The crews were instructed to follow the wall of the engine room around the upper walkway and to locate the hatch to the base oil tank. Their priority was to search in and around the tank for Shaun McDonald. The search crews were not to enter the tank. The conditions were exceedingly dangerous. As Mr Wood explained the smoke conditions were so difficult and disorientating that it was impossible to judge distance accurately and two feet could seem more like six feet. The use of water on hot surfaces to control the fire produced steam and the consequent danger of sustaining burns.

Fire fighters Mark Kindness and Adam Bruce were instructed to take over from the team ahead of them and to go with a hose beyond the hatch to hold back the fire and to allow a search of the tank to be conducted safely by the search team. The fire was on the level below them and it was described in the evidence like fighting a fire in a chimney. Mr Kindness and Mr Bruce passed the tank hatch on their right hand side and continued along the walkway in the direction of the flight of stairs to the main deck and as they held the fire back for the search team they found Mr McDonald's body at the bottom of the stairs. Mr Kindness was instantly convinced that Mr McDonald was dead and that assessment was confirmed by Mr Bruce. Mr Kindness explained that this was an exercise of judgment by him and his colleague in the most difficult circumstances. Neither of them as in any doubt at all that they were dealing with a fatality. The time of the discovery of Mr McDonald's body is recorded at 09.39 hours in the incident log.

It would have been difficult if not possible to remove Mr McDonald's body at that time in the prevailing conditions. In any event it was (and still is) standard practice for all Fire and Rescue Services in this country to leave a body where it is found to preserve any evidence and until it is safe to remove the body. The M.V. Far Service was equipped with a fire fighting system which involved flooding the

engine room with carbon dioxide gas. That system had not been activated earlier as it would have been fatal to anyone who might have still been alive in the engine room. After Shaun McDonald's body was found a decision was made to activate the system and to allow the fire to be extinguished. Crews of the Fire and Rescue Service entered the engine room on the Monday morning to check the fire was out and the body of Mr McDonald was recovered later that day.

The first matter which requires to be decided is the cause of the accident resulting in the death of Shaun King McDonald. The circumstances of the accident are as straightforward as they are unfortunate in their coincidence. Mr Swails, having been requested to allow access for a crane, shut off the valves on the Tanker and on the Turbo Vac and halted the vacuum pump in order to move the Turbo Vac. He did not advise anyone of this although it was not suggested this procedure was in any way unusual. Unfortunately at that precise moment signals were given by Mr Buchan and Mr Ian McDonald from the deck of the M.V. Far Service to Darren Adams on the quay that the job of removing the base oil was completed. It was expected that Mr Adams would shut the valves and that Mr Swails would stop the pump. In ignorance of the fact that Mr Swails had just closed the valves Darren Adams moved the levers on the valves to a horizontal position thinking that he was now shutting off the valves when in fact he was reopening them. On board the ship Mr Chesser having finished the extraction of the oil and in the knowledge that Mr Ian McDonald had signalled the end of the job to those on the quayside expected that the vacuum pump would be switched off and the valves closed. He was, therefore, not surprised when the suction stopped and he started to disconnect the hose on the last section going into the base oil tank. However, with the opening of the valves the vacuum was lost and the oil started to pour back down the pipe in a torrent which prevented the reconnection of the hoses.

The oil flowed rapidly across the walkway and down on to the lower level of the engine room. It is likely that the oil splashed on and formed a mist around the engine and other machinery. Base oil has a flash point in the range of 73°C to 75°C and auto-ignites at 225°C. In the opinion of the Health & Safety executive expert Mr David Richardson it is most probable that the spilled oil

impinged upon hot surfaces and formed oil vapour. The ignition of that vapour could have occurred from a variety of causes including auto-ignition from contact with the engine exhaust manifold, hot surfaces within the induction manifold, turbocharger impeller or valve gear, or hot surfaces on or within the electric motors. Ignition could also be caused by arcing or sparking in the electric motors. Other possible causes of ignition were considered but thought to be unlikely.

The fire spread rapidly and no one had an opportunity to warn Mr McDonald who was still working in the base oil tank. However, the fire alarm sounded, the emergency lights came on and warning lights flashed. Although Mr McDonald was wearing earplugs to work in a noisy environment the evidence indicated that he would have been aware of the crisis. Mr McDonald has managed to climb the ladder from the tank on to the walkway of the engine room and to make his way to the foot of the stairs leading to the hatch on to the main deck. At the foot of the steps he has collapsed. When his body was recovered it was found that he was lying on top of the section of hose which had been thrown back through the hatch when it was closed. This poses the significant question as to whether or not Mr McDonald could have made it to safety if the hatch had been kept open for a little longer. The gap in time between the start of the fire and the closure of the hatch is difficult to ascertain but it is to be measured in minutes rather than seconds. The forlorn hope was that he had managed to get out of the tank and escape from the engine room by an alternative route. It was the evidence of all those who were on the deck that there was little hope at the time that Mr McDonald could have survived if he was still in the engine room. It is impossible to conclude that the assessment there and then by the witnesses was wrong. The expert evidence given by Mr David Richardson supports that assessment. In his opinion the route up the stairs was practically impossible even before the door was closed. After the fire became established Mr McDonald had a matter of only tens of seconds at the most to effect his escape. As Mr Richardson explained the stairs would be impassable because of the flue effect created by the hatch being left open. He concluded that it would be extremely unlikely for Mr McDonald to have got from the engine room without serious injury.

I am deeply conscious of the concern and upset felt by the family of Mr McDonald about the decision to secure the hatch. Having listened to the witnesses and having had an opportunity to consider all of the evidence with care I conclude that in the circumstances and given the nature of the fire and the danger presented to those on board the ship that it was essential to control the fire by closing the hatch. In my opinion there was no likelihood that Mr McDonald might have escaped without sustaining injuries which would prove to be fatal. I cannot hold that there was ever any possibility at all that Mr McDonald could have survived within the engine room.

The next matters which require to be considered are the related questions of the reasonable precautions by which the accident and Mr McDonald's death might have been avoided and the defects in the system of working which contributed to the accident resulting in his death. The system of carrying out this particular work was defective in several respects. There was no proper risk assessment carried out to identify the obvious danger of the base oil igniting in the event of a spill. There was simply no consideration given to any hazard presented by restarting the ship's engines or having machinery operate in the vicinity of the extraction of the base oil. The configuration of the levers on the valves of the Tanker was confusing and the open and closed positions should have been clearly signed. The use of short sections of hoses connected with manual couplings was also not best suited to the job in hand. Mr McDonald should not have been allowed to work on his own within the tank and should not have been supervised by a watchman with effective means of communication to those on the quayside and to the ship's officers on the bridge. There should have been more effective communication about when the job was finished and when the equipment could be disconnected. All emergency equipment such as the emergency escape kits should have been kept at the points where they could have been of use.

The Permit to Work system should have been the starting point in identifying the hazards in the particular operation and to identify the safe system of work. The Enviroco charge hand met the ship's First Officer to obtain the Permit to Work and that procedure should have identified any risks inherent in the

work to be carried out. In particular, the hazard of base oil igniting while being removed from a tank by suction along a series of connected hoses through an engine room in which the ship's engines and other machinery were running was obvious and should have been easily identified. The responsibility for that risk assessment lies with Enviroco Plc as the company carrying out the task of tank cleaning and with Farstad Shipping Ltd as the ship owner has a responsibility as well. The Merchant Shipping regulations place the responsibility for the safe navigation of the ship on the Master. Navigation includes starting the engines in harbour. The Merchant Shipping (Master's Discretion) Regulations 1997 (S.I. 1997 No 2886) make it a criminal offence for "the owner, charterer or manager of a ship or any other person.... (to)... prevent or restrict the master of the ship from taking or executing any decision which, in the master's professional judgement, is necessary for the safe navigation of the ship". While it was clear that Asco Plc, as the charterer, had instructed the Captain to make the ship ready to move to the south base at about 08.30 hours there was no evidence that any pressure had been placed on him to move before it was safe to do so. The real failure was in not transmitting a copy of the Permit to Work to Asco Plc to advise of the nature and progress of the work and any associated hazards. As a result of that Asco Plc was not aware of any possible conflict between any safety considerations and its wish to carry out commercial activities. The new system in place demands that a copy of the Permit be faxed to the Asco Plc base to avoid any confusion on that issue. It was, of course, part of Asco's activities in the first place that had led to the request for the Turbo Vac to be moved on the quay to allow access by a heavy load.

The Enviroco Health, Safety, the Environment and Quality policy statement dated February 21, 200 was produced by me. This policy statement is based on a similar policy statement for Asco Plc but has been adapted to be more specific to Enviroco's function. This document describes how various tasks are to be accomplished in terms of a Permit to Work system but it does not require hazards to be identified. In the task based risk assessment form dated 5 April 2002 which was in use at the time of the accident it was necessary only to obtain the necessary Permit to Work and to observe any conditions stated in that Permit

subject to personal safety and protection taking priority. In particular the risk assessment form does not deal with the possible hazard of fire raising from the ignition of any spillage of oil or with the issue of having a member of the team acting as lookout at the tank hatch and with good communication to the shore team and the shipboard team.

After the death of Shaun McDonald the task based risk assessment form was revised and reissued on 29 July 2002. This document purports to cover all of the lessons learned from this accident. The important step in carrying out a particular job is to obtain the Permit to Work and to view the work site for hazards and risks in order to confirm the Permit is valid. The new form deals with the question of the entry to a confined space and in particular identifies the hazard posed by engines or other heat sources. The control in place is to remove all heat sources and ignition factors and, in short, all forms of ignition or heat source have to be fully isolated and cold. This means that when tank cleaning is taking place the ship should be dead in the sense that there should be no heat source. That has been the method of safe working from July 2002. There should also be a toolbox talk involving Enviroco staff and the crew of the vessel outlining the method of working and a full safety induction course should be given by the chief mate of the vessel to cover the emergency exits and the position of the emergency sets. Two people should be working in the tank to be cleaned and a standby man with emergency equipment and a communications device should be stationed at the tank hatch at all times. In addition there should be good communication between the shore team and the ship board team.

If reasonable precautions like these had been in place prior to July 2002 then the accident which resulted in the death of Shaun King McDonald might have been avoided.

Appendix

1. William May Buchan
2. Joseph Chesser
3. Ian McDonald
4. William Joseph Swails
5. Darren Brian Adams
6. Angus George Milne Smart
7. Gordon Grant Thomson
8. Mark Hunter Kindness
9. Andrew Graham Hislop
10. Stewart George Wood
11. Gordon Alexander Gray
12. Andrew Daniel Coueslant
13. George Shaun Burns
14. Keith McPherson Carson
15. Russell Breen
16. Robert Lewis Kirkby
17. Russell Collins
18. Christopher David Williams
19. Ronald Bruce
20. James Summers Bain
21. Domenico Bicocchi
22. Michael Gibbon
23. James Watt
24. David Guy Richardson
25. Andrew Joseph Meikle

And by Affidavit

26. James and Mackintosh McKenzie
27. Grant Stenhouse
28. Alan Keith Brown
29. James Edward Fletcher
30. Stuart Hawksworth
31. Ian Ross