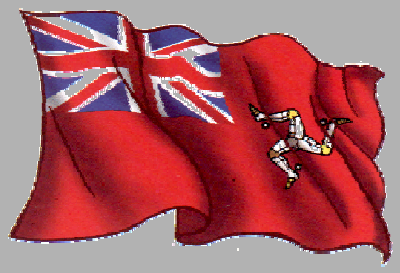
Isle of Man
Marine Administration



Casualty Investigation

Report CA 95

Crane Failure / Fatality

Sallie Knutsen

2nd October 2005

Isle of Man
Government
Reiltys Ellan Vannin

Statement of Intent

Extract from

The Isle of Man Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2001 – Regulation 4:

"*The fundamental purpose of investigating a casualty, an accident, or an incident under these Regulations is to determine its circumstances and the causes with the aim of improving the safety of life at sea and the avoidance of accidents in the future.*

It is not the purpose to apportion liability, nor, except so far as is necessary to achieve the fundamental purpose, to apportion blame"

Vessels Particulars

NAME:	Sallie Knutsen
SHIP TYPE:	Tanker
KEEL LAID:	20th October 1998
GROSS TONNAGE:	87,828
DEAD WEIGHT:	153,617
REGISTERED LENGTH (m)	265.84
CALL SIGN:	MDSK 3
IMO NUMBER:	9169627
MANAGING COMPANY:	VShips Norway AS
OWNER:	Knutsen OAS Shipping

Sallie Knutsen

Contents

1. Abbreviations and Definitions

AMOS – Electronic planned maintenance system.

Bulldog clamp – in this context, an item of hardware designed for the clamping of steel wire ropes, they rely on friction and proper adjustment to perform correctly.

Current transformer – a wire coil which by means of induction produces a signal current which can be measured as part of a control circuit.

Competent Authority – A suitably qualified and/or trained body or person(s) appointed by the flag state to undertake statutory inspections on their behalf.

Competent Person – *regulations require that a person chosen to act as a competent person in the examination and testing of plant should be over 18 and have the practical and theoretical knowledge required for the performance of thorough examinations and tests of ships lifting plant*. This should include actual experience of the type of machinery or plant concerned sufficient to be able to detect any defects or weaknesses and to assess their importance in relation to strength, stability and functions of the machinery or plant (COSWP 7.6.2)

COSWP – Code of Safe Working Practices for Merchant Seamen – a code giving guidance on health and safety at work which covers safe working procedures for almost all shipboard work activities and is widely used to supplement owner's safety management system.

DNV – Det Norske Veritas – the vessels classification society who also conducted tensile testing on the failed wire at their test facility in Bergen.

Hard eye - a loop formed as a termination in a wire, synthetic, or natural rope which has a steel thimble arrangement to prevent the eye deforming under load.

Headroom – the available space above an object without coming into contact with another object or obstruction.

ISM Code – International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention – A mandatory code which entered into force 1 July 1998 setting out procedures that must be adopted by companies to enhance safety and prevent environmental pollution.

MEDEVAC – Medical evacuation performed in an emergency by helicopter where road transport is not possible or where transportation time must be kept to a minimum.

Pallet fork –an item of lifting equipment designed to safely suspend stores pallets for movement by crane.

Power breaker – a mechanical device designed to safely separate the electrical conductors providing power to a piece of equipment.

Soft eye – a loop formed as a termination in a wire, synthetic, or natural rope which has no thimble arrangement to prevent the eye deforming under load.

“Talurite” ferrule clamps – a recognised method of terminating wire falls or ropes, consisting of alloy tubes fitted over the live and dead end of the wire and then compressed to form a secure clamp, usually stamped with a safe working load.

Thermal overload – a device having a bimetallic strip as one of its components. The strip bends due to differential expansion of the metals when they become hot as high current passes through the overload. When the strip bends far enough a tripping device operates, different tripping values can be set by adjusting how far the strip has to bend and which is proportional to the temperature of the strip (the purpose of thermal overloads is to protect the motor from damage due to heat associated with high electric currents being drawn by the motor, speed of response depends on how far the drawn current exceeds the set current but is typically less than a second), they require to be manually reset before further use is possible.

Wire Strop – A length of wire with hard eyes at each end and used for lifting operations to make handling easier - load tested and certified for the load they can safely carry they are subject to regular inspections to ensure they remain suitable for use.

2. Summary

On the 2nd of October 2005 the Isle of Man registered shuttle tanker “Sallie Knutsen” was loading stores and provisions whilst discharging her cargo of crude oil at the Statoil terminal in Mongstad, Norway.

The stores and provisions were being loaded using the ships gantry crane and a pallet fork supplied by the terminal. During this operation the crane’s wire rope parted, causing the pallet fork to fall on the Chief Engineer, who was underneath the crane.

The Chief Engineer later died due to the extent of his injuries.

Subsequent investigation revealed that the cranes hoisting limit switch and load sensing unit were inoperative. This allowed the cranes hook block to be hoisted into its housing to the extent that the tension in the wire rope exceeded its breaking load.

This report examines the contributory factors which resulted in the accident with a view to prevent similar occurrences in the future.

3. Narrative of Events

Introduction

The following text provides an account of the events leading up to the accident and is provided by witness statements and collection of evidence on board the vessel and at the technical managers' offices.

All times indicated are local times in 24 hour clock format.

The "Sallie Knutsen" arrived at the Port of Mongstad in Norway on the 2nd of October 2005. The vessel moored at Statoil jetty No.7 and was all fast at 04:16.

05:12 the "Sallie Knutsen" commenced discharging her cargo of crude oil.

The Master was advised by the Ships Agent that the ship's stores and provisions were scheduled for delivery by tug boat at around 11:00. This was subsequently delayed to around 15:00.

The ship's traverse crane (monorail gantry crane) was prepared for the stores and provisions operation.

Figure 1

Gantry crane looking from port aft

At approximately 15:30 the tug boat "Bulldog", was positioned stern to, at the Sallie Knutsens starboard aft quarter, below the monorail crane.

"Bulldog" had five crew members on board. Three of the crew members were on deck for the lifting operation and the tug boat's skipper was in the wheelhouse keeping the tug boat in position and supervising the crew members on deck.

“Bulldog” had thirty five pallets of stores and provisions for the Sallie Knutsen. To facilitate their transfer, Statoil had provided the tug boat with a purpose designed lifting device known as a pallet fork (see figure 2).

Figure 2

Pallet fork lying in horizontal position

There were also nine, two hundred litre drums of waste oil to back load from the Sallie Knutsen to the “Bulldog”.

Figure 3

Figure of nine two hundred litre drums placed against starboard side rail

At 15:35, eleven of the twenty four officers and crew on board the Sallie Knutsen were involved in handling the stores and provisions.

- The Bosun as crane operator.
- The Second Officer (Safety Officer) supervising the operation.
- Six crew members assisting as required.
- The Pumpman as relief crane operator.
- The Chief Engineer checking supplied articles against invoices and packing lists.
- The Electrician standing-by for any operational problems with the crane.

The pumpman relieved the bosun as crane operator after two or three pallets had been lifted on board.

After ten to twelve pallets had been received, a pallet of chemical drums was prepared for loading on board. The chemical drums were of the plastic twenty five litre type and were stacked three high on the pallet and wrapped in plastic shrink wrap.

The pallet of chemical drums was landed safely on deck and the bosun and one of the crew members disengaged the pallet fork.

The pumpman then hoisted the pallet fork clear using the gantry crane and when this was elevated clear of the area the pumpman started moving the crane outboard towards the vessel's starboard side.

At approximately 16:15 the gantry crane's wire rope parted as the crane was moved outboard. The pallet fork fell, striking the Chief Engineer (who was checking stores received) on the right hand side of the back of his head.

The Chief Engineer fell with the force of the impact, striking the left hand side of his head on the edge of a save-all coaming surrounding a fuel oil vent pipe.

Figure 4

Figure of fuel oil vent pipe save-all

The Chief Engineer was rendered unconscious, lying prone on the deck with the pallet fork covering his mid section.

Figure 5

Black dotted box indicates position of chemical pallet
White arrow indicates the position of the Chief Engineer when he was hit
White dotted line indicates transverse movement of the crane

At the time of the accident the officers and crew involved were not aware that the Chief Engineer was working below the crane and pallet fork.

Immediately after the accident, the officers and crew acted quickly, removing the pallet fork from the Chief Engineer and moving it to a safe distance away from the scene of the accident.

The Chief Engineer was then put in the recovery position and the Second Officer asked one of the crewmen to get some blankets.

The Second Officer contacted the Chief Officer in the cargo control room by radio and reported that there had been an accident on the poopdeck, he then went on to report that the Chief Engineer was injured and unconscious.

The ship's medical team was mobilised at this time.

The Chief Officer asked if an ambulance was required, and the Second Officer confirmed it was.

The Chief Officer contacted the Statoil terminal control at Mongstad, requesting immediate medical assistance. The Master was contacted at the same time and was appraised of the situation.

The terminal responded very quickly and informed the Chief Officer that an ambulance was on its way.

The Master informed the Chief Officer that he would relieve him in the cargo control room and control communications.

The Chief Officer then made his way to the poopdeck to better evaluate the situation. Upon his arrival he realised the seriousness of the situation and informed the Master accordingly.

16:20 the Master and Chief Officer had a brief discussion which concluded with the Master requesting a MEDEVAC to take the Chief Engineer ashore.

16:25 the Master stopped cargo operations and the Statoil first aid personnel arrived on board from the terminal.

The Statoil first aid team took control of the situation and started giving the Chief Engineer oxygen.

The Master asked the first aid team if they had the helicopter contact information, as the ship carries air band radios and he was concerned about the Chief Engineer's condition.

The first aid team advised the Master that they had contacted the helicopter which should arrive within the next few minutes.

16:35 the Master appraised the vessel's management company of the situation.

16:45 the helicopter landed at the designated landing area on the port side, forward of the manifold.

The doctor disembarked the helicopter at this location and was escorted to the scene of the accident.

The helicopter pilot then contacted the Master and asked if they could move the helicopter to the starboard side in front of the accommodation.

The Master agreed and the bosun and one of the crew went forward to clear the accommodation ladder and move the safety gear to that location.

The helicopter then moved to this closer position.

The Second Officer requested that all crew members clear the accident area and return to the accommodation. All responded at once and the door was closed once they were inside.

The Statoil first aid team assisted the doctor and crew from the helicopter and the Chief Officer and Second Officer assisted as required.

17:04 the Doctor and Chief Officer arrived at the cargo control room.

The Master, Doctor and Chief Officer moved to the Master's office where the Doctor informed the Master that the Chief Engineer had died, due to the extent of his injuries. This was later confirmed by the coroner in his report.

Before the vessel departed the terminal, teams representing the vessel's managers and the terminal operators, in addition to the police attended the vessel to commence an investigation into the accident.

The Isle of Man Marine Administration was advised by fax on Monday the 3rd of October 2005, but no investigator was able to attend the incident prior to the vessels departure. Attendance was subsequently arranged for the vessel's return to Mongstad.

The Isle of Man investigation team attended the vessel on Sunday 9th October

4. Comments and Analysis

The investigation discovered a number of factors which were considered contributory to the accident. These have been divided into the following sub headings for clarity.

- **Crane Failure**
- **Manufacturer's procedures for crane operations**
- **Company procedures for crane operations**
- **Maintenance and testing of the crane**
- **Headroom limitations**
- **Safe working practices**
- **Hours of work and rest**
- **Weather and external factors**
- **Staff Qualifications**
- **The Company's Safety Management System**

Crane Failure

Failure of the steel wire rope
Referencing Det Norske Veritas Test Report No.BGN-R3105382 (part of which is attached as annex 1) the conclusion drawn was that the wire failed due to a single overload (over-tension) event and also that the wire was weakened by around twenty percent due to the securing method.

When the wire rope was terminated with the "Talurite", ferrule clamps as shown in figure 6 (as required by the manufacturer's instruction manual), under test, the wire parted / failed at 14.3 tonnes. When the wire rope was tested using the bulldog clamps positioned as per figures 7 and 8 (the situation found after the accident), the wire parted / failed at 11.7 tonnes.

When the crane wire failed, the only thing suspended from the hook was the pallet fork which weighed 240kg and its attachment wire.

The crane had a safe working load of 5 tonnes.

The crane manufacturer's instruction manual shows a wire rope of 16mm, 18x 7 with fibre core (WFC) and shows the correct method for terminating the free end (dead end) of the wire rope using a thimble eye and "Talurite", ferrule clamps as shown in figure 6.

Figure 6

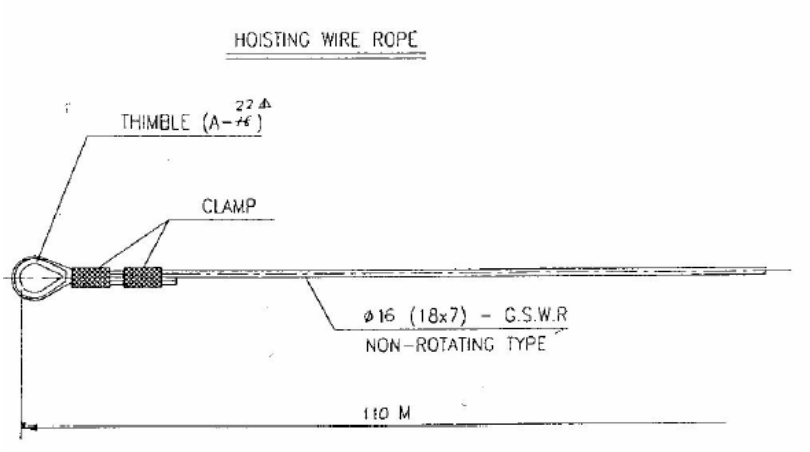


Figure 6 Showing Talurite, ferrule clamps from Manufacturer's Instruction manual

The method used onboard the Sallie Knutsen consisted of three bulldog clamps of the "U" bolt type as shown in Figure 7.

From figure 7 it can be seen that the clamps were not attached in the same direction. The first and last clamps were attached with the saddle on the free (dead) end of the wire rope and the "U" bolt around the main wire rope (live end). The clamp in the middle was attached in the opposite (correct) direction.

Figures 7 and 8 also show the position where the wire rope parted.

Figure 7

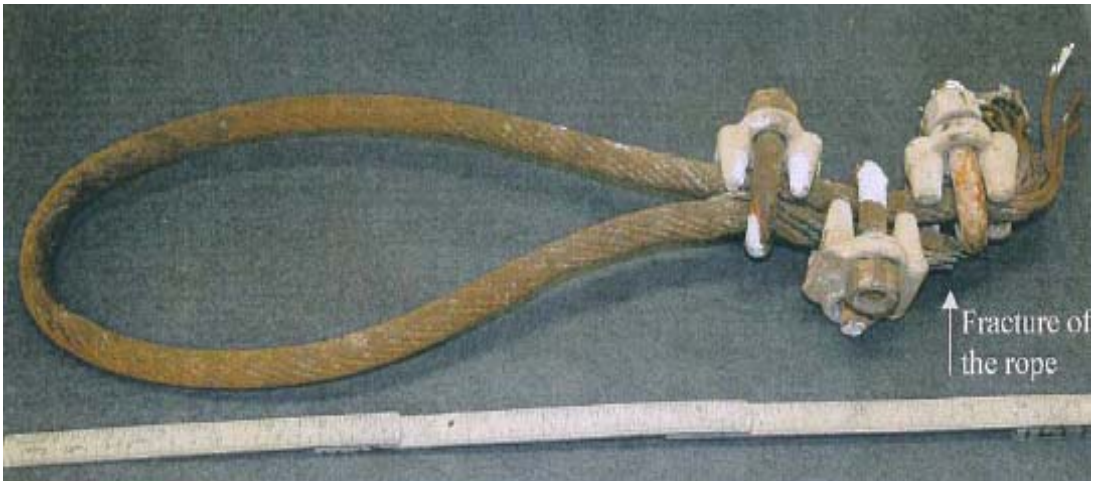
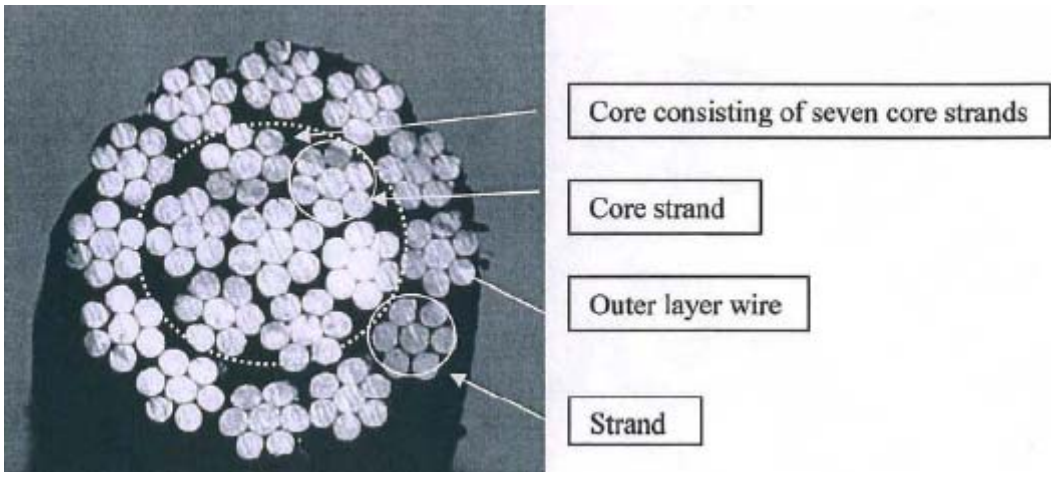


Figure 8

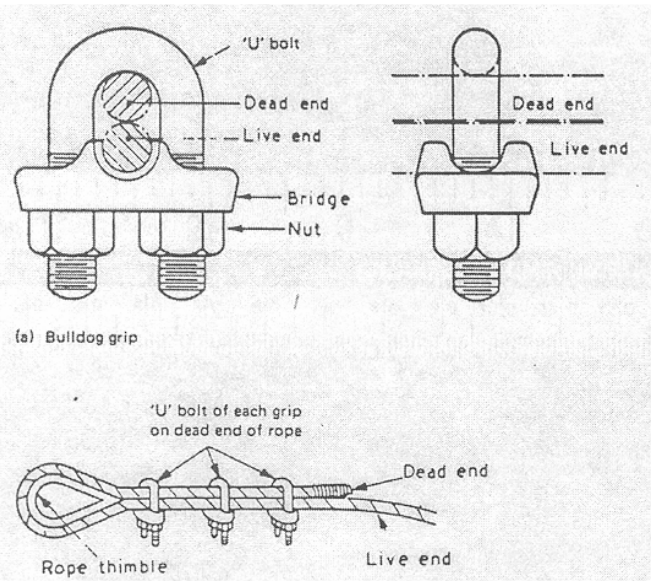
The construction of the steel wire rope was 16mm, 19 x 7 (12/6/1) with steel core (WSC). Figure 9, shows a cross section of it.

Figure 9



The Isle of Man has issued technical information on the use of bulldog clamps for wire rope terminations (industry circular No.7) the arrangement being shown in Figure 10. This method of termination is only accepted for lifeboat falls and not for crane wires.

Figure 10



1. As a general rule the clamps should be placed at intervals of 6 x Wire Rope diameter.

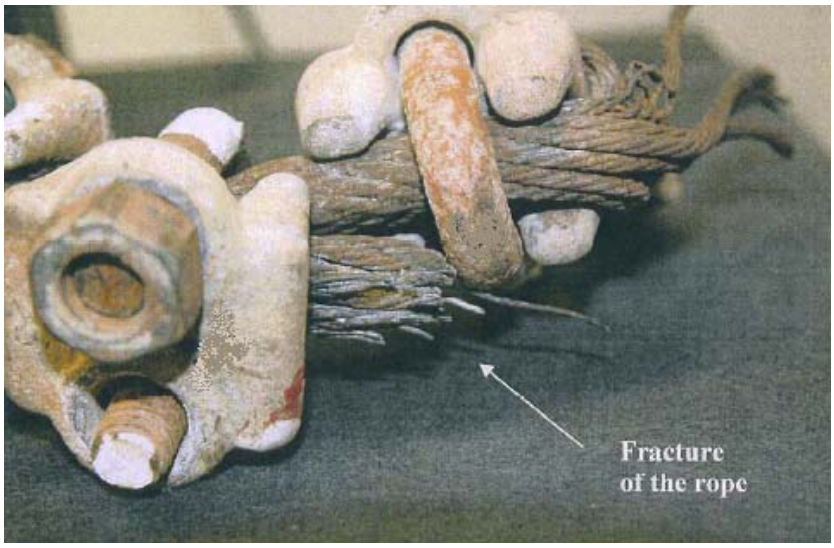
2. The minimum number of clamps is to be three.

3. After an initial load the clamps should be retightened paying special attention to deformation of the wire rope.

Referring to figures 7 and 8, it can be seen that the first and last bulldog clamps are fitted incorrectly with the saddle attached to the free end (dead end) and the “U” bolt clamping the main wire (live end). The spacing between each clamp is also well below the six times wire rope diameter required.

The wire rope has parted / fractured at the contact point of the first “U” bolt from the free rope end (dead end). This is clearly shown in figure 11.

Figure 11



A valid test certificate for the wire rope could not be found on board the vessel.

Summarising

The accident occurred as a direct result of the steel wire rope parting due to a single overload. This has been confirmed through “Det Norske Veritas, Test Report No. BGN-R3105382

The termination of the crane’s wire rope did not incorporate the “Talurite”, ferrule clamp as described in the manufacturer’s instruction manual. (Figure 6)

Two of the three bulldog clips used for the wire termination were not fitted correctly (Figures 7 and 8) and when tested by DNV this termination showed a reduction of the breaking load of the wire rope by around twenty percent, however this was still more than twice the safe working load of the crane which is 5.0 tonnes.

The test certificate for the wire rope was not available onboard and therefore the safe working load of the wire would not be known by ships staff.

Failure of the crane's safety devices.

The electrical circuit which controls the crane’s horizontal movement along the gantry and the hook block’s vertical movement incorporates different types of safety features. The safety features include “limit switches”, “electro magnetic brake for the winch” “overload protection for the crane”, and “overload protection for the hoisting motor”.

Figures 12 and 13 show the hook block and limit switch on the port side of the gantry crane (*the opposite side from the accident*). The arrows are indicating the positions of the limit switch, its operating lever and the “U” shaped steel bar which would normally make contact with the operating lever.

When the wire parted, nobody could confirm if the limit switch lever was present or not, nor was it actually witnessed that the hook block rose home into the housing, allowing the hoisting motor to effectively pull against a stationary wire.

It is likely that the limit switch lever was missing and the hook block was hoisted into its housing, since a force was produced in the wire sufficient in magnitude for it to fail.

Figure 12

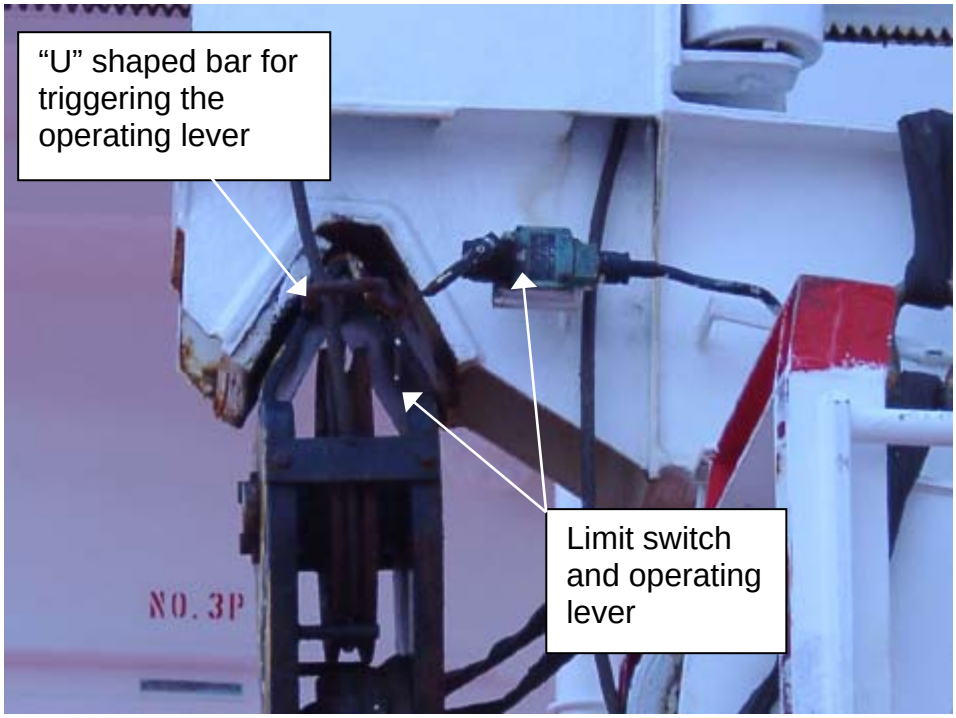
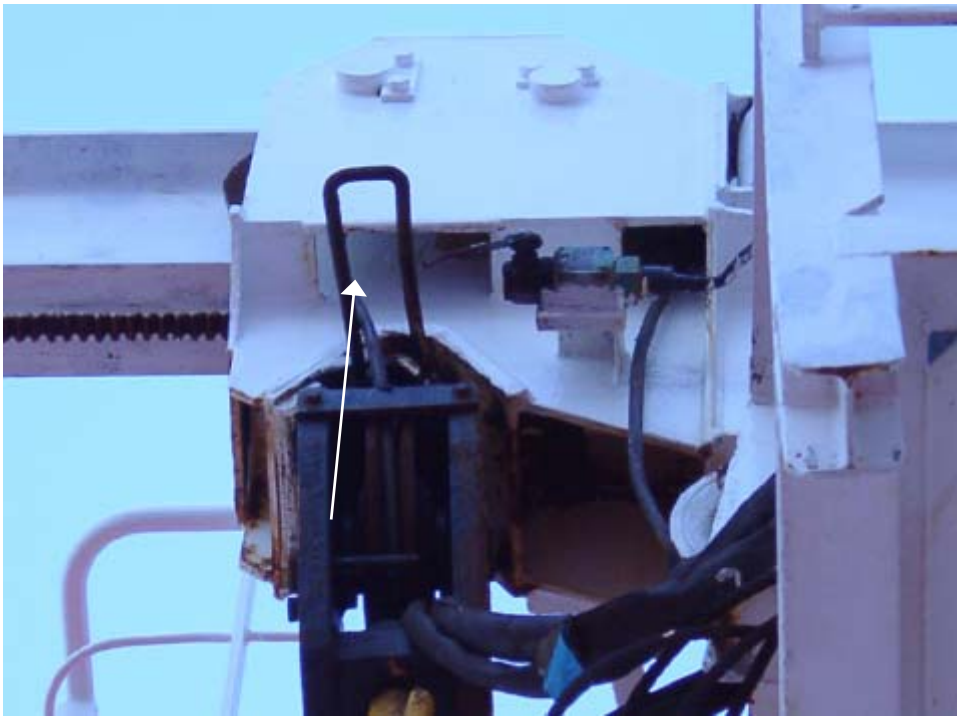


Figure 13



As can be seen from figures 12 and 13, both the "U" shaped bar which should trigger the operating lever and the operating lever itself, have been deformed in such a way that the limit switch may not operate when hoisting.

Figures 14 and 15 show the hook block housing and the limit switch on the starboard side of the gantry crane following the accident.

Figure 14

Figure 15

The figures show the operating lever missing from the limit switch.

From the interviews with the officers and crew, not one person was able to confirm that the operating lever of the limit switch was in position prior to the incident even though company safety management procedures require a visual check be carried out before using the crane.

Evidence indicates that it was not in place, as subsequent testing proved that the switch would have worked had the operating lever been present and come into contact with the hook block.

“DNV Test Report No. BGN-R3105382” shows that the wire rope failed due to a sudden single over-tension. As the lifting hook block was free to move, this over-tension is likely to have been caused by hoisting the hook block all the way back into its housing, supporting the evidence that the lever was not present.

The crane overload protection consists of a current transformer (marked CT11 on figure16), a microprocessor controlled load sensing unit (marked as LSO1 on figure17) and an electromagnetic brake which forms part of the winch drum and which is applied when the power source is removed.

Figure 16

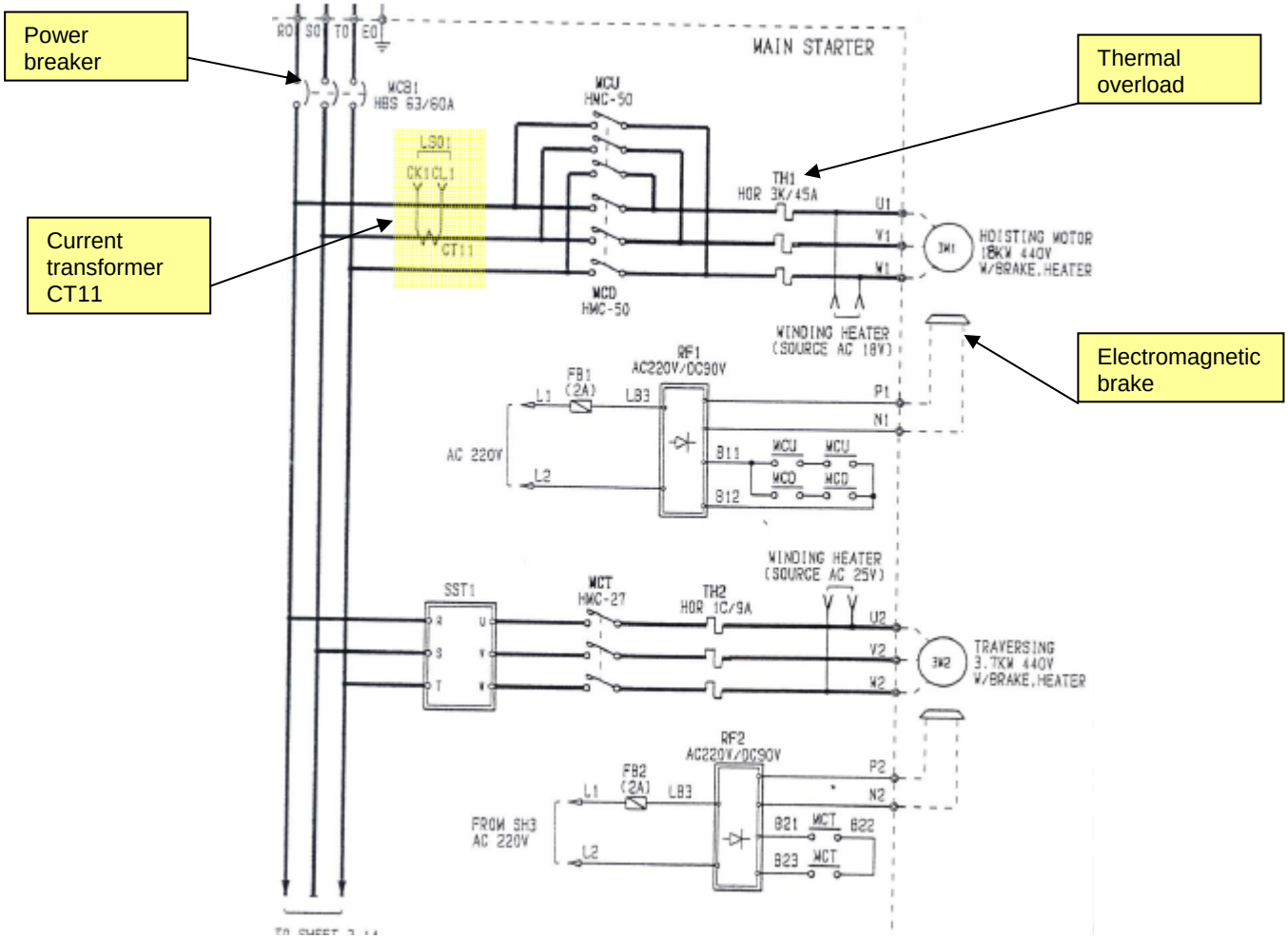
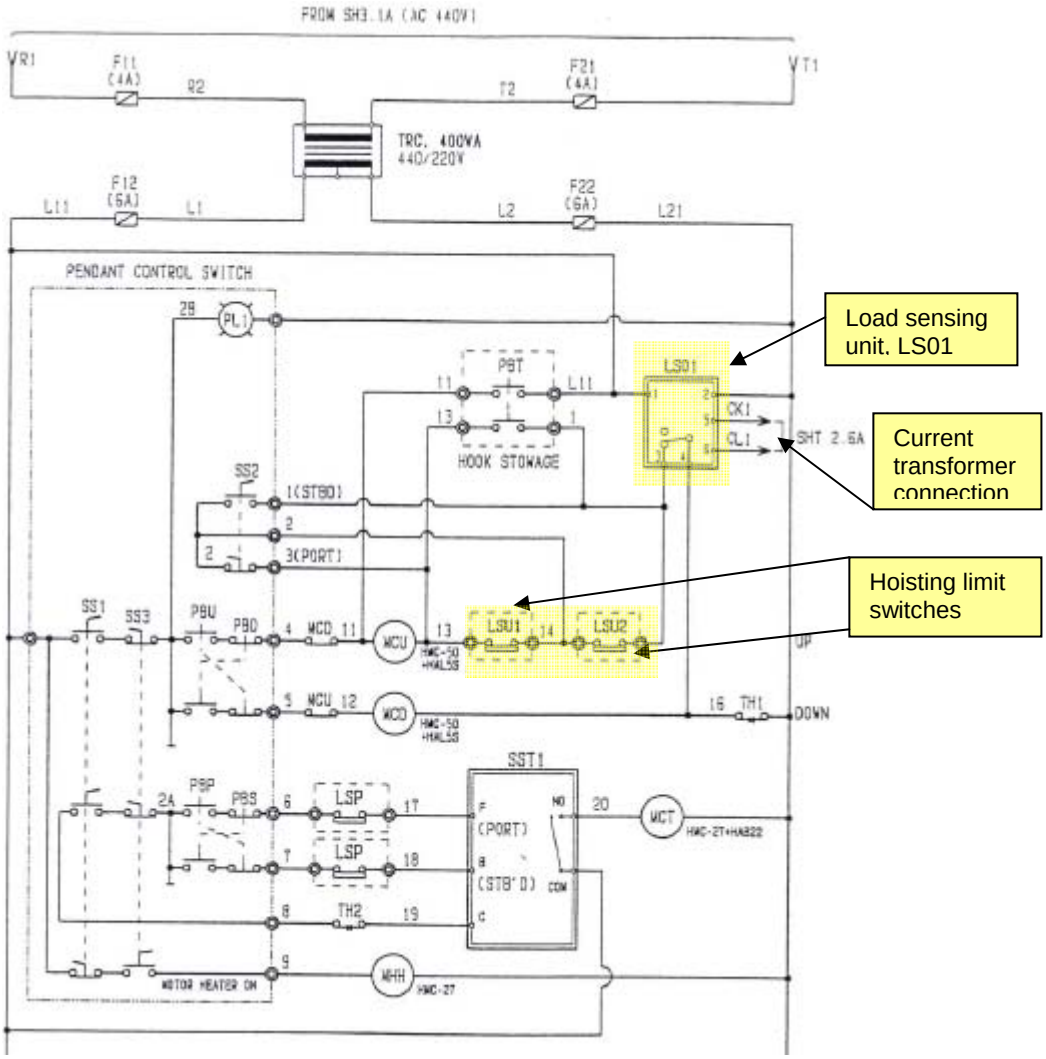


Figure 17



When hoisting, the current drawn by the motor is measured by the current transformer, the load sensing unit then compares the measured (signal) current with a predetermined level set on the unit.

When the load sensing unit detects the hoisting motor is drawing too much current, for a period longer than two seconds, the unit goes into “overload protection” and locks out, to prevent overloading the crane.

Once the unit has locked out, it needs to be manually reset. Following the incident, no manual reset was required to operate the crane. It was later found that the current transformer had failed and was not actually providing an input signal to the load sensing unit, when it actually failed could not be determined.

This effectively prevented the overload protection functioning as a safety device.

The hoisting motor overload protection consists of a thermal overload attached to the power breaker for the motor. Close visual examination after the accident did not show any obvious signs of damage which would prevent normal operation taking place. This indicates the wire snapped before the overload had sufficient time to operate the circuit breaker and apply the brake as it didn't need to be re-set.

Summarising
The wire rope failed due to a single over-tension, created by the winch motor hoisting the hook block against its housing.

The hoisting limit switch did not operate, allowing the hook block to be hoisted into its housing.

The crane winch load sensing unit was non operational.

The single remaining safety device was the hoisting motor thermal overload which appeared to be fully functional but failed to trip the power breaker and apply the brake before the wire failed.

Manufacturer's procedures for crane operations

The crane manufacturer's instruction manual contains a list of twelve procedures and tests which must be carried out on the crane before use (see *Annex 2*). For the purpose of this investigation Item Nos. 1, 2, 4 and 5 are analysed below as they are considered to have a direct influence on the sequence of events.

- *Annex 2, Inspection Item No.1*
  "***Check for obstacles in the working area***"

  As can be seen from figure 18. There were nine, two hundred litre barrels of oil residue arranged against the ship's starboard side rails for back loading to "Bulldog".

  The drums were positioned directly within the working area of the crane.

  With the barrels in this position, the ship's side rail could not be folded down and hence the height of the side rails determined the height at which the stores and provisions needed to be raised to enable stores and provisions to be lifted on board.

Figure 18

Figure 19 clearly shows the position the side rails should be lowered to, when lifting stores and provisions onboard with the crane.

Figure 19

With the ships side rail lowered, the lifting height of stores and provisions over the deck area is reduced to approximately two hundred and fifty millimetres, with the rail raised this is increased to approximately one thousand millimetres and would have the effect of reducing the amount of free lifting height between the hook block and the gantry.

- *Annex 2, Inspection Item No.2*
  "Check whether the stopper on either end of the rail is deformed or lost or its connection bolts are loose"

  There are two types of stopper on this crane which limit the transverse movement. The first is a limit switch which is operated by a stopper attached to the rail and the second is a mechanical stop attached to the underside of the rail. Whilst the mechanical stops are mentioned in the "before using inspection" the electrical limit switch stops are not.

  The stoppers were not checked / tested before the stores and provisions operation started.

- *Annex 2, Inspection Item No.4*
  "Working condition of control switches; interlocking circuit"

  The testing of the control switches was limited to "whether the crane moved from port to starboard, starboard to port and whether the required hook block moved up and down".

  The interlock which prevents any movement of the crane when more than one control switch is operated was not tested.

- *Annex 2, Inspection Item No.5*
  "Checking if the over winding preventive limit switch lever operates or not"

  The over winding limit switch (LSU1 or LSU2 depending on which side of the vessel the crane is being used) was not apparently tested. This switch prevents the hook block from being hoisted into the block housing and over tensioning the wire rope (Figures 12 and 13 show the hook block, block housing and the limit switch, on the port side), the switch is activated by the lever coming into contact with the hook block.

  The crane's safety devices were inspected after the accident and the starboard hoist limit switch was found to be working electrically, but the operating lever was missing.

  This would allow the crane operator to hoist the hook block into the block housing thus over tensioning the wire rope.

  The port side hoist limit switch was also inspected and although having the lever attached it was found not to be functioning electrically, it was also noted that the operating lever was bent and may have been unable to make physical contact with the hook block.

Summarising
The crane manufacturer's instruction manual defines twelve inspection items which must be checked before using the crane for any operation.

Not all of them were checked prior to the stores/provisions operation.

The ship's side rail had not been lowered to facilitate safer lifting of items over the ships side.

The maker's instruction manual "before using inspection" omits the testing of the electrical transverse limit switch stops.

Company procedures for crane operations

Before the vessel's arrival in Mongstad, a meeting was held between the senior officers to discuss the vessel's operations in port. This included cargo, stores and provisions operations

The stores and provisions operation was routine and one in which all members of the crew were familiar with.

The company's "Ship Operation Manual, Chapter 8, Safety and Pollution precautions, page 16 of 16", has been attached as *Annex 3*.

Annex 3, 8.10.2 Use of deck cranes, Item 4

"The crane and lifting appliances shall be visually checked prior to operation"

This contradicts the manufacturer's instructions, attached as *Annex 2* which state testing must be done prior to every operation.

Maintenance and Testing of the crane

The maintenance and test records for the crane were checked on the vessels electronic planned maintenance system (AMOS).

Three maintenance descriptions were found for the gantry crane, these consisted of:-

- LU006 - "lubrication" (monthly) – all thread ends required for adjustment purpose must be kept greased, all lubrication points must be lubricated by means of a high pressure grease gun.

- CH047 - "check of crane" (three monthly) – greasing of wire ropes, check oil level in gearboxes, function check of brakes, drive unit, screw joints, and end stops – see instruction book IO-9 chapter maintenance.

- OC008 - "change oil" (six monthly) – check oil in winches/travel unit, check load hook for damage, check runway, check power supply, check wire rope - see instruction book IO-9 chapter maintenance.

The vessel was in scheduled dry dock in June 2004 where two maintenance items were performed on the crane, the job specifications are shown in the following two paragraphs. This work was carried out by yard personnel though the load testing and close up inspection was performed by an external crane specialist who provided the certificate of load testing.

- "All ball bearings on traverse beam support wheels to be changed with owners supply new bearings".

- "5-yearly survey – wires to be un-reeved, hooks, shackles, blocks to be transported to workshop to be opened up, cleaned, inspected, lubricated, re-assembled, tested and stamped. Wires and sheaves to be visually inspected. All materials to be replaced and cranes davits to be tested by means of water bags and/or dynamometer. Certificate to be issued".

The "5-yearly survey" carried out by the crane specialist did not include performance checks and electrical/physical testing of the safety devices and motors as per manufacturers instructions because this was not specifically requested by the shipyard in the terms of the subcontract, it was verbally advised to the investigators that it was assumed that the yard would separately arrange for this to be done.

If the crane wires were un-reeved and examined on board the vessel, it is possible that the end securing point was not disconnected, however it should have been observed that the wire end securing arrangement was incorrectly made using bulldog clamps forming a "soft eye" rather than thimble eye and "talurite" ferrule clamps forming a "hard eye" as per manufacturers recommendations.

The "5-yearly survey" completion/acceptance tests were not witnessed by the vessels classification society because they were not requested to do so, the "competent person" fulfils this requirement.

The fact that "5-yearly survey" was stated in the dry dock specification would tend to infer that these checks should be included, physical testing of crane performance and correct safety device function was not carried out, because it was not clearly stated in the work scope description from the superintendent to the yard or the yard to the subcontractor.

The last paragraph of COSWP 7.6.3 states "An examination of a sample of parts of a lifting appliance is not sufficient to constitute a thorough examination". It would be reasonable to expect that the competent person should have questioned the limited scope of items to be inspected.

Summarising

The five yearly thorough examination was not fully completed.

The Company, competent authority and ship yard do not appear to have planned or coordinated the examination. Each party involved, wrongly assumed that one of the others had taken responsibility for the outstanding items of the examination.

The AMOS planned maintenance system contains only three work instructions associated with the gantry crane and does not include yearly and five yearly thorough examination items.

The manufacturer's instruction manual does not include yearly or five yearly thorough examination items.

Headroom limitations

The maximum headroom between the crane gantry and the main-deck without anything suspended is 8m (see figures 20 and 21). When any load is suspended, this headroom is reduced, limiting the remaining amount of vertical travel available.

Figure 20

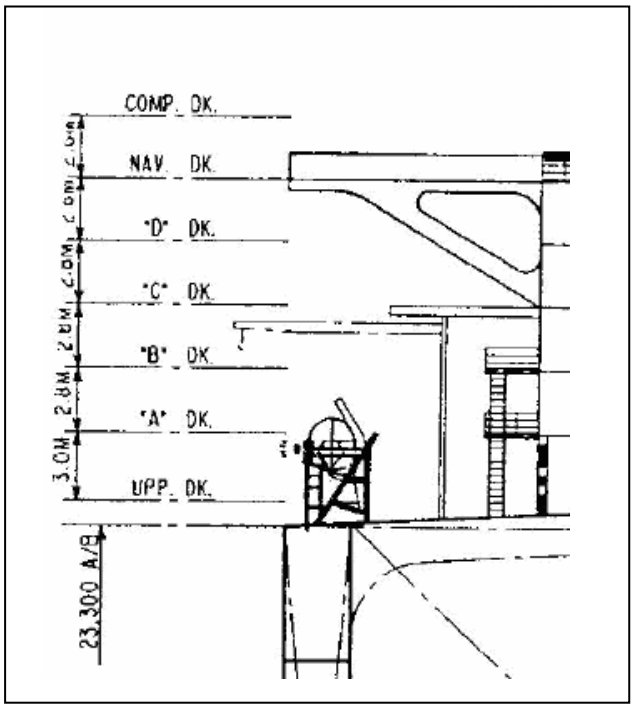
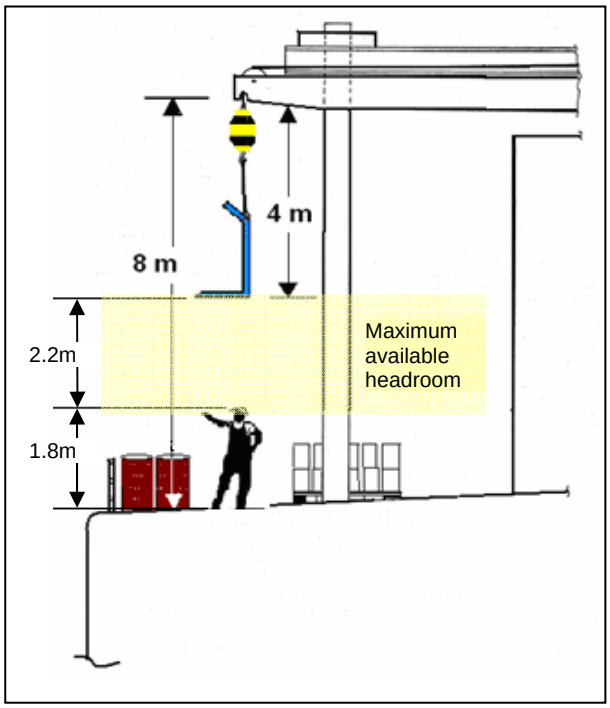


Figure 21



During this operation, the pallet fork, which was used in conjunction with a "wire strop" and the hook block to lift the pallets, was measured to be 4m in total. This had the effect of reducing the available headroom from 8m to 4m.

To increase safety during hoisting operations, the ship's side rail underneath the gantry crane is designed to be lowered in order to maximise the amount of available headroom. Unfortunately in this incident, oil drums were stowed against this section of railing for back loading to the tug (for disposal) and prevented it from being lowered (see figures 18 and 19).

To clear these obstructions, the pallet fork had to be lifted approximately 1m higher up and reduced the available headroom to approximately 3m.

There were eleven crew members working in close proximity to the hoisting operation, a natural reaction to close proximity working, by the crane operator, is to hoist the load clear of head height, as can be seen on figure 21 this reduces the available headroom further still.

With less available headroom above the hook block, when hoisting, the reaction time before the hook block comes up to the limit switch and ultimately the gantry housing position is reduced.

The limited headroom available both increased the likelihood of an accident occurring and increased the likelihood of such an accident causing serious injury.

Summarising
Due to a several different factors, the headroom above the hook block was reduced which limited the degree of free movement available. It also reduced the time needed for the hook to ultimately reach the crane gantry housing (as the limit switch with a missing lever arm would fail to arrest its travel).

Safe working practices

Of the eleven persons involved in the stores operation, not one person witnessed the actual accident, the Chief Engineer was working underneath a suspended load and the crane operator did not have a clear view of the operation.

It is extremely dangerous to be positioned underneath a suspended load. Despite his years of experience, the Chief Engineer allowed himself to become distracted by his concerns to ensure stores were correctly received on board and positioned himself underneath the crane when it was being used.

All ship's staff were familiar with the "Code of Safe Working Practices for Merchant Seamen" regarding crane operations, it was determined however that safe working practices when working with suspended loads had not been observed during this particular stores and provisions operation.

Summarising
Basic safety procedures were not properly followed. Had physical testing and visual inspection been properly carried out and with better overall awareness of the surroundings by everyone involved in the operation, the Chief Engineer may not have been in danger.

Hours of work and rest

The recorded hours of work and rest for all officers and crew onboard the vessel were inspected and showed compliance with the Isle of Man Merchant Shipping (Manning and Training) Regulations 1996 (as amended), STCW 95 and ILO180.

Duty rosters were posted and working periods observed.

Summarising
From the records of hours of work and rest maintained onboard and the interviews conducted with the officers and crew, fatigue does not appear to be a contributory factor to the accident.

Weather and external factors

The weather conditions were good from the vessel arriving alongside in Mongstad on the 2nd of October 2005, until its departure on the 3rd of October 2005.

The tug boat “Bulldog” should have arrived alongside the Sallie Knutsen at 1100. This was delayed until 1500 but had no effect on subsequent stores operations.

Summarising
The weather conditions were not considered to be a contributory factor to the accident and the “Bulldog’s” late arrival alongside did not put any additional pressure on the vessels crew to complete the stores and provisions operation quickly.

Staff Qualifications

The ships Master issues crane operator certificates to the officers and crew who have undergone training in the use of the crane. The certificate indicates that the holder knows how to operate the crane and has an understanding of the safety devices fitted to the crane and how to check or inspect them.

The pumpman had not been issued with such a certificate however when the Officers and crews training records were inspected. The pumpman and bosun, who were acting as the crane operators, had actually received training and had experience in the operation of the crane.

Summarising
The pumpman had not been issued with a crane operator’s certificate by the Master; although his training records showed that he had been instructed and had experience in the operation of the crane.

The Company's Safety Management System

Reporting of Accidents, Incidents and Near Misses
The Company has procedures in place for reporting accidents, incidents and near misses. The reports are sent into the company for comment, analysis and further investigation. The findings are then published in quarterly reports and casualty information notes where serious injury has occurred.

The Master of the vessel is required to report any accidents, incidents and near misses to the company and should there be a serious incident or one in which casualties are involved the company should report to the flag state.

The safety officer's (officials) duties and responsibilities include the investigation of any accidents, incidents and near misses. The investigation should conclude in a report which is presented to the Master and the company and includes any recommendations.

A copy of the report then remains onboard the vessel and is available to the members of the safety committee.

The safety committee meeting minutes should include any accidents, incidents and near misses.

There had been two previous incidents involving the use of this vessel's gantry crane.

In April 2002 the hoisting limit switch had failed, allowing the hook block to be hoisted into its housing. This produced an over tension in the wire causing one of the wire ropes strands to part. There was no investigation report and no record of an accident, incident or near miss in the ships safety committee minutes.

In March 2003 the ship's liferafts had been delivered back to the ship after being ashore for servicing. After completion of cargo operations the gantry crane was used to move the liferafts to the port side of the vessel. The hoisting limit switch failed and the hook block was hoisted into its housing, parting the wire rope. The hook block fell and landed on one of the liferafts damaging its casing. There were no incident reports onboard the ship. No records of the investigation and no records in the ship's safety committee minutes.

The company's "Analysis of Accidents and Incidents" for the first quarter of 2003 has a report on the incident in March 2003 and the conclusions drawn from it. The "Remedial Action" proposed by the vessel was to change the limit switch and put a new procedure in place which states that "safety check will be done manually on the auto switch before the crane will be taken into use".

This procedure was never implemented onboard or in the Company's safety management system.

Other company incident reports from the same quarter include under "Remedial Action", "Safe working practices to be emphasised at shipboard safety meetings".

Summarising
There was no evidence on the vessel or in the company offices of any reports having been completed by the Master for the incidents in April 2002 and March 2003.

There was no evidence of any investigations completed by the safety officer for the same incidents.

The safety committee minutes for April 2002 and March 2003 do not contain any reference to the incidents.

The vessel's remedial action which proposed a new procedure for testing the hoisting limit switch before using the crane was not implemented onboard or within the safety management system.

Crane operating procedures
The company procedures regarding training in the use of deck cranes proved ineffective, allowing the manufacturer's "before using inspection" items to be omitted from normal work practices. This prevented the ship's staff from detecting the failure of the crane's safety devices.

Defect / Non conformance reporting
The Company has procedures in place which allows ship's staff to report defects and failures of equipment; by using a non conformance report. There are descriptions of two previous failures of the hoisting limit switches discovered in the Chief Engineers "monthly technical reports" for April 2002 and March 2003, though no non-conformance reports were located for these incidents.

The monthly technical reports are sent to the company for review by the technical department. The March 2003 report proposed modifications to the cranes safety system by installing a second limit switch half a metre below the end position (housing).

No evidence was found or supplied (onboard the vessel or at The Company's offices) to show that either of these two failures had been followed up. There were no available records of the company responding to the proposed modifications.

Summarising
The Chief Engineer's monthly technical report identified two previous failures and following the second incident recommended that modifications be made to the crane. No evidence of defect or incident reports (or follow up actions) as required by the SMS were found for these. No records of discussions at safety meetings or investigations by the vessels safety officer for these occurrences were located.

5. Conclusions

The company's safety management system failed to enforce basic safety checks which should be carried out on the crane before any operation.

The Chief Engineer's monthly technical reports identified two previous failures of the limit switches (April 2002 and March 2003). Following the second incident, modifications were proposed to be made to the crane's safety device arrangement although the company's defect / non-conformance reporting system was not used and neither the company or the ships officers properly followed up on the proposed modifications.

The vessels' remedial action from the March 2003 incident proposed a new procedure for testing the hoisting limit switch before using the crane. This was not implemented onboard or written within the safety management system and was not therefore incorporated in the vessels safe working practices.

The safety management system in use at the time of the previous incidents failed to identify that the basic procedures for reporting, investigating, drawing conclusions and making recommendations about accidents, incidents and near misses were not being followed, either on ship or on shore.

The safe working load of the wire rope fitted at the time of the accident was similar to the original wire rope. The change in wire rope specification is not considered a contributory factor in the accident.

"Det Norske Veritas Test report No. BGN-R3105382" confirmed that terminating the wire rope with the bulldog clamps instead of the "talurite", ferrule clamp, effectively reduced the breaking load of the wire by around twenty percent from 14.3 tonnes to 11.7 tonnes.

The manufacturer's instruction manual clearly shows the use of a thimble and "talurite" ferrule clamps for terminating the wire rope. The use of bulldog clamps had a direct bearing on the failure of the wire rope. The Isle of Man Marine Administration has guidance for when bulldog clamps may be used and these do not include termination of crane wire ropes

Failure of two of the crane's safety devices; the hoisting limit switch and the load sensing unit (through failure of the current transformer), allowed the hook block to be hoisted into its housing causing a single over tension of the wire rope which resulted in the wire rope parting.

The crane manufacturer's instruction manual contains twelve inspection items which must be checked or tested before use of the crane, these were not all done. The visual examination required by the company's crane procedures failed to detect a possible dangerous condition of the hoisting limit switch.

Maintenance of the crane was not being properly carried out as the vessels planned maintenance system and the manufacturers instructions do not identify yearly or five yearly checks.

The Company, competent authority and ship yard do not appear to have planned or coordinated the five yearly examination of the crane. Each party involved, wrongly assumed that one of the others had taken responsibility for the outstanding items of the examination.

The ship's side rail had not been lowered for the stores and provisions operation. The height of the ship's side rail determined the height at which the stores and provisions were lifted on board and this had a direct bearing on the severity of the accident since the load had to be lifted higher, reducing the headroom and available safety space between the hook block and crane as well as increasing the distance the load fell before striking the Chief Engineer.

The officers and crew involved in the stores and provisions operation were familiar with the requirements of the "Code of Safe Working Practices for Merchant Seamen" regarding crane operations. However basic safety awareness was not observed on this occasion.

6. Recommendations

The company's safety management system should inter alia; provide procedures which have been developed to allow a structured approach to safety management. The system should include procedures for reporting accidents, incidents, near misses and defects using controlled documents and forms.

Use of controlled documentation and reporting requirements creates a "loop" from creation to conclusion and should ensure identified problems are properly followed up.

The Company and ship's staff should follow procedures at all times and the safety management system should be able to detect the use of uncontrolled documentation through the master's review and company internal audits.

The company should :

- follow up on any type of accident or incident report drawing its own conclusions and recommendations and if necessary due to the severity of the accident/incident issue a fleet safety circular.

- ensure that lifting plant is maintained in good working order through the use of a systematic planned maintenance system. The maintenance system should include any manufacturer's instructions. The detailed descriptions of yearly and five yearly inspections should also be included and take into account the requirements of International and National legislation and relevant codes of practice.

- ensure that the testing procedures contained within any instruction manual should be stringently followed.

- ensure ship's staff should be made aware that operational safety when working with cranes requires that the area is free of obstruction, persons involved in the operation have a clear view of the area and lifting equipment safety devices are function tested - all crane operators should be sufficiently trained to take all these aspects into account.

- take steps to ensure that all wire ropes supplied to the vessel are correctly certified and The Company and Master should ensure that valid documents are available at all relevant locations.

- ensure that the termination of crane wire ropes follow the manufacturer's instructions and should never be terminated using bulldog clamps.

Manufacturers should :

- ensure that any safety devices fitted to their equipment should fail safe. The failure of any safety device should shut down equipment safely until the cause has been found and rectified.

7. Actions Taken

Immediately following the accident the Company's own investigation identified weaknesses within their safety management system.

The Company have completely revised the crane operating procedures and practices within the safety management system and have incorporated new safety devices within the crane's safety systems.

The Company's electronic planned maintenance system now incorporates all the "before using checklist" items contained within the manufacturer's instruction manual. The Company have also added additional checks and inspections that they feel will further improve the safety and reliability of the crane.

All Officers and crew involved in crane operations are to be re-trained to take into account the new procedures, practices and safety checks.

8. Acknowledgements

The Isle of Man Marine Administration wish to acknowledge the full co-operation and assistance offered by the following during the course of the investigation:-

Ship's Staff

Knutsen OAS Shipping

VShips Norway AS

Statoil ASA

DNV Bergen

Teekay Marine Services

Oriental Precision and Engineering Co.Ltd.

Keppel Verolme

Mongstad Police

Grieg Logisitics AS

Annex 1 – extract from DNV report BGN-R3105382

DET NORSKE VERITAS

TECHNICAL REPORT

Date of first issue:	Project No.:
2005-10-14	74531366
Approved by: Hans-Erik Berge Head of Section Hans-Erik Berge	Organisational unit: Failure Investigation & Condition Mng.
Client: Statoil ASA	Client ref.: Stein Ove Dyngeland

DET NORSKE VERITAS AS
REGION NORDIC COUNTRIES

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Summary:
Det Norske Veritas, Section for Failure Investigation and Condition Management, has received parts of a fractured steel wire rope for failure analyses. The wire rope was used on a provision crane on a vessel.
The performed examinaiton has revealed:

- The fracture of the rope is observed to be located at the first U-bolt clip, with reference to the free rope end ("dead end"). The fracture can be characterized as an overload fracture. All single wires, except from one wire, have failed due to overload.
- Deformation and wear damage in the fracture initiation points has reduced the cross section of some of the wires. Part of this deformation damage is most likely caused by the U-bolt clip.
- The general condition in the fracture area of the rope can be characterized as very dry both inside and outside. General corrosion was observed on the wires. Corrosion pits were not observed in the fracture initiation points.
- The U-bolt clips on the rope were observed as incorrectly attached /1 – 3/.
- Full scale tensile testing showed a 20% reduction of the breaking load on a test performed with U-bolt clips attached as on the fractured rope (11.7 tons) compared to test with Talurite (14.3 tons). This indicates that the breaking load of the wire rope has been decreased because of the clips.

Report No.:	Subject Group:
BGN-R3105382	

Report title:
Failure analysis of steel wire rope

Provision crane

Work carried out by:
Kristine Bjørvik Andersen / Inger-Lise Tangen
Kristine Bjørvik Andersen Inger-Lise Tangen

Work verified by:
Ketil Melkeraaen
Ketil Melkeraaen

Date of this revision:	Rev. No.:	Number of pages:
2005-10-18	02	16

Indexing terms

Key words	Service Area
Wire Fracture	Asset Operation
	Market Sector: Transportation

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Annex 2 – extract from Makers crane manual – "before using" inspection

2. BEFORE USING INSPECTION

The following items should be examined by the responsible worker to repair faulty locations before working.

(TABLE.1)

No.	Inspection Item		Explanation
1	Check for obstacles in the working area.		Check for hindrances standing in the ways of hoist.
2	Check whether the stopper on either end of the rail is deformed or lost or its connection bolts are loosened.		
3	Check for broken grounding wire for metallic pushbutton station; for loosened connection; and for abnormalities in the through part of the pushbutton switch cable.		Run through the inside since if metallic case develops electric leakage, electric shock hazards are involved.
4	Working condition of control switches; interlocking circuit.		Whether the switch is jammed up. Can the switch be reset by itself?
5	Checking if the overwinding preventive limit switch lever operates or not.		Is not the pin slipped off?
6	wire rope	Breaks of strands.	Less than 10% of the total number of strands within one twist.
		Kindy rope; deformation; corrosion.	
		Anchor; fitting; pin; sheave.	Lock; split cotter pin-abnormalities such as wear.
		Corrosion of fittings.	shortage of oil at roots; breakage; corrosion.

No.	Inspection Item		Explanation
7	Hook Block	Rotation of hook nut.	Slipping-off of split pin and set screw.
		Sheave damages.	Damages: wear of groove.
		Damages and loosened connections in sheave case, key plate (name plate).	Loosened set screws.
8	Crack, wear and deformation of hook.		Eye-checking.
9	Check the slinging means for abnormalities.		Deformation: extension; breaks: etc.
10	Check for loosened carriage side plate, loosened connections and missing split cotter pins.		Check the side plate for deformation.
11	Grounding condition of I-beam and hoist body.		Inspection of grounding wire: checking for loosened connection.
12	No-load trial operation. Check for effectual brake. Whether the wire-rope is justly rolled up the drum. Check for abnormal noise and vibration.		

Annex 3 – extract from Owners procedures – use of deck cranes

8.10 General safety precautions

8.10.1 Avoiding slips and falls

Slips and falls are one of the main reasons for personal injuries onboard. The Company believes that a proactive approach in identifying potential hazards and take necessary action in advance, will reduce this kind of accidents.

The following measures will reduce the risk of slips and falls;

- Potential dangerous working areas shall have a noon slip surface
- Any oil on deck, walkways etc shall be cleaned up immediately, every crewmember have a responsibility to ensure that this is adhered to
- Access and work areas shall be kept clear of obstructions
- Any openings (hatches, trunks, manholes etc) through which a person may fall shall be fenced in
- Working aloft shall not be undertaken before the working aloft permit have been verified by Master and all safety precautions as given in chapter 4 have been dealt with.

8.10.2 Use of deck cranes

When using deck cranes or other lifting appliances, the following shall be complied with;

- Only trained personnel shall handle the crane and they shall be familiar with the common hand signals used during crane operations
- The personnel using the crane shall be well known with the crane's maximum allowable lifting capacity and it's limitations
- The crane and lifting appliances shall be visually checked prior to operation
- Assisting personnel shall be instructed to stand clear of hanging cargo at any time

8.10.3 Securing walkways

Walkways shall be inspected and maintained at regular intervals to ensure that they are in a suitable condition.
Walkways shall be kept clear of any obstructions to ensure free passage at any time

Annex 4 – Planned Maintenance System - work descriptions

Work Order 05/3262

Discipline: CHIEF OFFICER

Priority: 0

"Sallie Knutsen"/Maintenance

10/02/2006 W6/06 Page 1 / 1

Title: LU006 - LUBRICATION
Component: 563.01. 563.01. PROVISION MONORAIL HOIST
Maker: OPEWON - ORIENTAL PRECISION&ENGINEERING CO.,LTD.
Type:
Serial No.:
Location: Accommodation / UPPER DECK

Planned Start: 31/10/2005 W44 Counter: 1 Month(s)
Planned Completion: 01/11/2005 W44 Last Done: 01/10/2005 Due RunningHours:

Work Description

CHECK THAT ALL GREASE POINTS ARE ADEQUATELY LUBRICATED.
ALL THREAD ENDS REQUIRED FOR ADJUSTMENT PURPOSE MUST ALWAYS BE KEPT GREASED.
REMOVE SURPLUS GREASE.
ALL LUBRICATION POINTS MUST BE LUBRICATED BY MEANS OF HIGH PRESSURE GREASE GUN.

VISUALLY INSPECT GEARBOXES OIL CONDITION FOR SIGNS OF WATER INGRESS ETC.
CHECK GEAR BOX OIL LEVELS.

VISUAL CHECK THAT WIRE ROPE IS ADEQUATELY GREASED.

LUBRICANTS:
Enclosed Gears Omala HD 220
Open gears Rhodina EP2
Grease Points Albida/Alvania EP2 (high temperature)

Date job done:
Actual Run Time:
Job performed by:
Job duration:
Spare parts used:
Notes:

Work Order 05/2590

Discipline: CHIEF OFFICER

Priority: 0

"Sallie Knutsen"/Maintenance

10/02/2006 W6/06 Page 1 / 2

Title:	CH047 - CHECK OF CRANE		
Component:	563.01.	563.01. PROVISION MONORAIL HOIST	
Maker:	OPEWON - ORIENTAL PRECISION&ENGINEERING CO.,LTD.		
Type:			
Serial No.:			
Location:	Accommodation / UPPER DECK		
Planned Start:	15/10/2005 W41	Counter: 3 Month(s)	
Planned Completion:	16/10/2005 W41	Last Done: 16/07/2005	Due RunningHours:

Work Description

CHECK OF CRANE -MECHANICAL

1 WIRE ROPES TO BE RUN OUT AND INSPECTED FOR DAMAGE, DEFORMATION OR CORROSION. ANY DAMAGE ISTO BE REPORTED
IMMEDIATELY TO CHIEF OFFICER. WIRE ROPES TO BE GREASED AFTER INSPECTION
ENSURE THAT ROPES LAY CORRECTLY ON THE DRUM WHEN HOISTING BACK IN

2 ATTACHMENT OF WIRE ROPE DEAD END: - REF DRWG No 0436607-40150
CHECK THAT WIRE ROPE END IS CORRECTLY ANCHORED, THIMBLE & FERRULE ARE IN GOOD CONDITION, & WIRE ROPE IS GREASED.
CHECK FOR WEAR ON THE ANCHOR SHAFT AND ENSURE THAT THE SHAFT KEY PLATE AND FASTENINGS ARE SECURE

3 LOAD BLOCKS, HOOKS AND SHEAVE ASSEMBLIES: REF DRWG No 0436607-40300
CHECK THE HOOK FOR CRACKS, WEAR OR DEFORMATION
CHECK THAT HOOK AND NUT ROTATE FREELY, WITH SMOOTH ROTATION OF THE THRUST BEARING.

CHECK THAT THE SPRING PINS AND SET SCREWS ARE SECURE AND IN GOOD ORDER
CHECK THAT THE ROPE SHEAVES ARE NOT DAMAGED AND ROTATE FREELY. ENSURE ALL PARTS ARE ADEQUATELY GREASED

4 HOISTING AND TRAVERSING WIRE ROPE SHEAVES & GUIDE ROLLERS:
INSPECT ALL SHEAVES & ROLLERS FOR DAMAGE, SMOOTH ROTATION AND ADEQUATE GREASING

5 TRAVERSING CARRIAGE ASSEMBLY: - REF DRWG No 0436607-30200
ENSURE THAT ALL KEY PLATES AND SPRING PINS ARE SECURE.
CHECK OIL LEVELS IN GEARBOXES, AND THAT ALL GREASE POINTS ARE LUBRICATED.

6 TRAVERSING BEAM, PINION WHEEL AND TOOTHED TRACK: - REF DRWG No 0436607-30200
CHECK TOOTHED TRACK FOR DAMAGED OR MISSING TEETH AND DEBRIS, REMOVE ANY DEPOSITS OR RUST BUILD UP WITH A
WIRE BRUSH, GREASE ON COMPLETION.
CHECK PINION WHEEL TEETH FOR DAMAGE, AND THAT PINION / RACK CLEARANCE IS CORRECT (4MM)
CHECK PORT & STBD TRAVERSING END STOPPERS ARE SECURE AND CORRECTLY POSITIONED

7 CARRY OUT A NO LOAD TEST OF HOISTING, LOWERING, TRAVERSING AND TRAVELLING BEAM OPERATIONS & BRAKING FUNCTIONS

8 NO-LOAD FUNCTION TEST OF HOIST & TRAVERSING LIMIT SWITCHES AND EMERGENCY STOP.
PRIOR TO TESTING CHECK THAT ALL LIMIT SWITCHES ARE SECURE IN CORRECT POSITIONS
THE HOIST LIMIT SWITCHES MUST STOP THE HOOKS CLEAR OF THE STORAGE POSITION, PREVENTING CONTACT WITH THE DRUM & OVER-WINDING OR OVER TENSIONING OF THE WIRE ROPE
PORT & STBD TRAVERSING LIMIT SWITCHES MUST CUT POWER IMMEDIATELY THE STRIKER ACTIVATES THE LIMIT SWITCH.
THE CORRECT FUNCTION OF ALL LIMIT SWITCHES IS TO BE WITNESSED BY THE CHIEF OFFICER

Work Order 05/0340

Discipline: ELECTRICAL OFFICER

Priority: 0

"Sallie Knutsen"/Maintenance

10/02/2006 W6/06 Page 1 / 1

Title:	MT002 - CHECK OF MOTOR		
Component:	563.01.01	EL. MOTOR HOISTING WINCH, PROV HOIST.	
Maker:			
Type:			
Serial No.:			
Location:	Accommodation / UPPER DECK		
Planned Start:	23/01/2006 W4	Counter: 12 Month(s)	
Planned Completion:	24/01/2006 W4	Last Done: 24/01/2005	Due RunningHours:

Work Description

1. KEEP THE MOTOR CLEAN AND MAKE SURE THERE IS FREE VENTILATION AND AIR FLOW.

2. CHECK FOR LOOSENED BOLTS OR NUTS IN THE BASE MOUNTING PART.

3. CHECK THE BEARING CONDITION BY LISTENING FOR ANY UNUSUAL NOISE.

4. MEASURE RESISTANCE BETWEEN THE EARTH AND EQUIPMENT TERMINALS.

5. CABLE CONDITION BETWEEN MOTOR AND STARTER TO BE CHECKED AND MEGGER TESTED. ALL GLANDS TO BE CHECKED FOR TIGHTNESS AND SEALING.

Results of insulation resistance to be recorded.

Date job done:
Actual Run Time:
Job performed by:
Job duration:
Spare parts used:
Notes:

Work Order 05/1631

Discipline: CHIEF OFFICER

Priority: 0

"Sallie Knutsen"/Maintenance

10/02/2006 W6/06 Page 1 / 1

Title:	OC008 - CHANGE OIL		
Component:	563.01.	563.01. PROVISION MONORAIL HOIST	
Maker:	OPEWON - ORIENTAL PRECISION&ENGINEERING CO.,LTD.		
Type:			
Serial No.:			
Location:	Accommodation / UPPER DECK		
Planned Start:	16/11/2005 W46	Counter: 6 Month(s)	
Planned Completion:	17/11/2005 W46	Last Done: 17/05/2005	Due RunningHours:

Work Description

OIL CHANGE:

CHANGE OIL IN HOIST AND TRAVEL UNIT GEAR BOXES.

LUBRICANT:
Gearbox: Omala HD 220

See also instruction book IO-9 Chapter MAINTENANCE.

Date job done:
Actual Run Time:
Job performed by:
Job duration:
Spare parts used:
Notes: