



GOBIERNO
DE ESPAÑA

MINISTERIO
DE TRANSPORTES, MOVILIDAD
Y AGENDA URBANA

SUBSECRETARÍA DE TRANSPORTES,
MOVILIDAD Y AGENDA URBANA

COMISIÓN PERMANENTE DE
INVESTIGACIÓN DE ACCIDENTES
E INCIDENTES MARÍTIMOS

CIAIM REPORT-10/2020

Fires in the engine room of the passenger and wheeled vehicle ferries
VOLCAN DE TENO, on May 16th 2019, and CHAMPION JET, on June 25th
2019.

NOTE

This report has been elaborated by the Maritime Accident and Incident Investigation Permanent Commission (CIAIM), which is regulated by article 265 of the reformed text of the Law of State Ports and the Merchant Navy, approved by Royal Legislative Decree 2/2011, of the 5th of September, and by Royal Decree 800/2011, of the 10th of June.

The aim of the CIAIM when investigating maritime accidents and incidents is to draw conclusions and extract lessons that allow the risk of future maritime accidents to be reduced, and hence contribute to maritime safety and to preventing contamination from shipping. To this end, the CIAIM carries out a technical investigation in each case in which it attempts to establish the causes and circumstances that, directly or indirectly, may have contributed to the accident or incident and, when necessary, to issue the appropriate safety recommendations.

The elaboration of this technical report is not intended in any way to prejudge any judicial decisions that may be produced, nor does it seek to evaluate responsibilities nor to determine guilt.

Fires in the engine room of the passenger and wheeled vehicle ferries VOLCAN DE TENO, on May 16th 2019, and CHAMPION JET, on June 25th 2019.



Figure 1. VOLCAN DE TENO



Figure 2. Accident site



Figure 3. CHAMPION JET 1



Figure 4.

1. SUMMARY

On the 16th of May 2019, the vessel VOLCAN DE TENO suffered a fire in one of its propulsion engines while navigating between Ceuta and Algeciras. The crew were able to extinguish the fire, and the vessel continued under its own power, being assisted by tugs when mooring. No personal injuries or contamination were caused.

On the 25th of June 2019, the vessel CHAMPION JET 1 suffered a fire in one of its propulsion engines while navigating between Santa Cruz de Tenerife and Las Palmas de Gran Canaria. The crew were able to extinguish the fire, and the vessel continued under its own power, being assisted by tugs when mooring. No personal injuries or contamination were caused.

Both vessels are operated by the same company, in both of them the main engines were the same brand and model, and in both cases, the fire started due to the same cause: breakage of the fuel pump anchor studs of one of the cylinders of the engine caused the pump fuel line to break, spraying fuel onto a hot spot on the engine that was not sufficiently insulated.

1.1. Investigation

The CIAIM was notified of the fire on the vessel VOLCAN DE TENO on the 17th of May 2019. The notification of the fire on the CHAMPION JET 1 was received on the 26th of June 2019. Both cases were provisionally classified as "serious accidents", and it was decided to open the investigations. A general meeting of the CIAIM ratified the classification of both events and the initiation of safety investigations. This report was reviewed in a CIAIM meeting on the 15th of July 2020 and, after being approved, was published on the October 2020.

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2. BASIC DATA

DATA ON THE CRAFT		
Name	VOLCAN DE TENO	CHAMPION JET 1
Ship registration	Spain / Santa Cruz de Tenerife	Cyprus / Limassol
Identification number	IMO number: 9221346	IMO number: 9151008
Type	High-speed passenger and wheeled vehicle ferry	High-speed passenger and wheeled vehicle ferry
Main characteristics	Total length: 95.47 m Beam: 26.60 m Tonnage: 6,363 GT Capacity: 900 passengers Construction material: Aluminium Hull type: Catamaran Propulsion: 4 water-jets powered by four RUSTON diesel engines, mod. 20RK270, of 7080kW each	Total length: 86.62 m Beam: 26.00 m Tonnage: 5,007 GT Capacity: 754 passengers Construction material: Aluminium Hull type: Catamaran Propulsion: 4 water-jets powered by four RUSTON diesel engines, mod. 20RK270, of 7076kW each
Owner and management	Naviera Armas S.A.	Property of Sea Jets Catamaran JV (Greece). Operated by Naviera Armas S.A.
Classification society	Bureau Veritas	Registro Italiano Navale
Constructional details	Constructed in 2000 by Incat Tasmania Pty Ltd (Australia)	Constructed in 1997 by Incat Tasmania Pty Ltd (Australia)
VOYAGE DETAILS		
Departure / destination ports	Ceuta / Algeciras	Santa Cruz / Las Palmas
Type of journey	Scheduled trip	Scheduled trip
Cargo data	24 passengers / 6 private cars / 1 motorcycle	62 passengers / unknown number of vehicles ¹
Crew	20 crew, complying with the minimum number required for safety	36 crew, complying with the minimum number required for safety
Documents	Dispatched correctly with valid certificates	Dispatched correctly with valid certificates
DATA ON THE INCIDENT		
Type of incident	Fire in engine room	Fire in engine room
Date and time	16th of May 2019, 23:00 local time	25th of June 2019, 20:10 local time
Location	Strait of Gibraltar 36°03'23"N 005°21'72"W	North of the island of Gran Canaria 28°11'00"N 015°23'00"W
Vessel operations	Navigating	Navigating
Location on board	Starboard engine room	Starboard engine room
Damage caused in the vessel	Diverse, see section 3	Diverse, see section 3
Personal injuries on board	No	No
Contamination	No	No
Damage other than to the vessel	No	No
Other personal injuries	No	No
MARINE AND METEOROLOGICAL CONDITIONS		
Wind	Beaufort force 1, from SW	Beaufort force 3, from NE
State of the sea	Calm (rippled)	Slight cresting
Visibility	Good	Good
INTERVENTION OF LAND-BASED AUTHORITIES AND REACTION OF EMERGENCY SERVICES		
Organisations involved	Centro de Coordinación de Salvamento (CCS) de Algeciras (Rescue Coordination Centre)	CCS Las Palmas
Means deployed	Salvage vessel LUZ DE MAR	Salvage vessel MIGUEL DE CERVANTES
Speed of intervention	Immediate	Immediate
Measures adopted	Escort. Intervention by the emergency services was not required.	Escort. Intervention by the emergency services was not required.
Results obtained	N/A	N/A

¹ The number of vehicles on board is not shown on any of the documents supplied to the CIAIM by the ARMAS company

2.1. Other data

The vessel VOLCAN DE TENO was acquired by Naviera Armas S.A. in 2017. Between 2010 and 2017 it had sailed under the Greek flag and belonged to a Greek shipping company.

The vessel CHAMPION JET 1 had been operated by Naviera Armas S.A. since March 2019. Before this, the vessel was operated by its registered owner.

3. DETAILED DESCRIPTION

This relation of events is based on the available data, declarations and reports. The times given refer to local time.

3.1. The fire on board the VOLCAN DE TENO



Figure 5. Accident site. VOLCAN DE TENO

On the 16th of May 2019, at 22:29, the high-speed passenger and wheeled vehicle ferry VOLCAN DE TENO cast off in the port of Ceuta, heading for Algeciras, with 20 crew, 24 passengers, 6 private cars and 1 motorcycle aboard. The vessel ran the regular Algeciras-Ceuta ferry route, and this was the fifth daily round trip between these two ports, and the second for the captain on board, who had taken over command in Algeciras at 17:00.

The voyage was uneventful, sailing at a speed of about 28 knots, until 23:00, when the CCTV monitors installed in the bridge showed flames in one of the main engines. The engine affected was the SOME (*Starboard Outer Main Engine*), in the starboard engine room.

After checking that there was no-one in the starboard engine room and that its access hatches were closed, the captain ordered the fuel valves to be closed, closed the fire dampers and stopped the propulsion engines in the starboard engine room. The port engines continued to operate normally.

At 23:02, the fire alarm of the engine room triggered. The fixed CO₂ fire extinguisher system was triggered and the passengers were immediately moved to the prow. As a preventive measure, hoses were run out and fire-extinction teams were deployed, in case the adjacent area needed cooling.

Fires in the engine room of the passenger and wheeled vehicle ferries VOLCAN DE TENO, on May 16th 2019, and CHAMPION JET, on June 25th 2019.

At 23:10, Algeciras CCS observed that the vessel VOLCAN DE TENO had reduced its speed considerably, and contacted the vessel on VHF channel 74. The vessel informed them about the fire, indicating that no immediate help was required.

The Algeciras CCS dispatched the salvage vessel LUZ DE MAR to escort the ferry and offer fire-fighting services should this be necessary.

At 23:16, the VOLCAN DE TENO informed the Algeciras CCS that they had used the CO2 extinguisher system in the engine room and that the fire was out.

The vessel continued to navigate using the port engines. Two pilots boarded the vessel and two tugs were used to assist the vessel to dock.

At 23:56 the vessel had docked in the port of Algeciras. The ramp was lowered and the passengers and vehicles disembarked without problems.

On the 17th of May, after ventilating the space and carrying out the appropriate checks, the starboard engine room could be accessed. During the first inspection, it was found that the fuel feed tube (a hollow bolt, or *banjo bolt*) of fuel pump 1B of the SOME had snapped off. At the same time, two of the studs holding the fuel pump to the engine block had snapped and a third had no nut.

The main engine affected is made by RUSTON, model 20RK270, producing 7,080kW (9,626 HP) at 1,030 rpm.

3.1.1. Damage caused by the fire in the VOLCAN DE TENO

There were no personal injuries, contamination nor damage other than to the vessel. The fire only affected the starboard engine room. Apart from the damage to the studs and the fuel line, the fire affected the following elements, components or systems:

- The electrical wiring of the engine.
- The sensor and wiring of the extinguisher system in the area around the SOME turbocharger.
- Emergency lighting and fluorescent tubes.
- Thermal insulation on the exhaust gas outlet near to the turbocharger.

The VOLCAN DE TENO was out of action for two and a half days while the damage was repaired.

3.2. The fire on board the CHAMPION JET 1

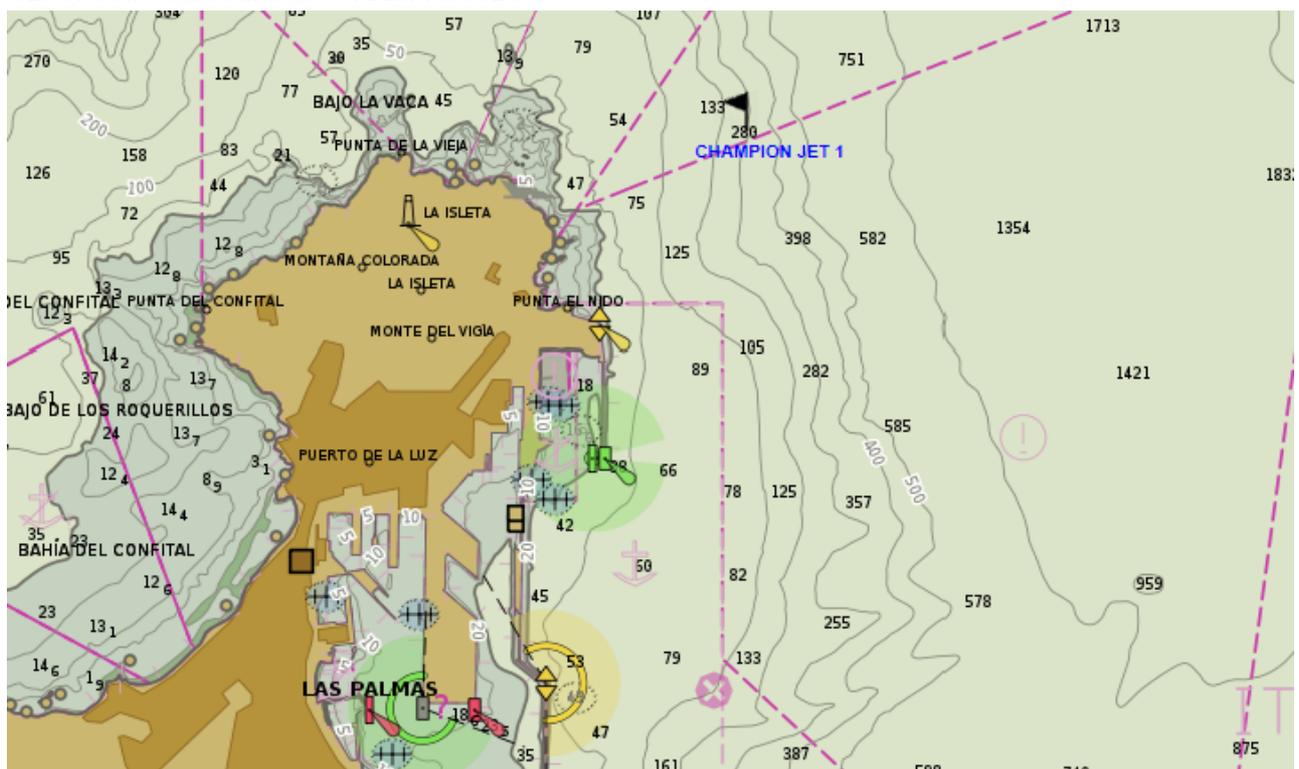


Figure 6. Accident site. CHAMPION JET 1

Fires in the engine room of the passenger and wheeled vehicle ferries VOLCAN DE TENO, on May 16th 2019, and CHAMPION JET, on June 25th 2019.

On the 25th of June 2019, at 18:30, the high-speed passenger and wheeled vehicle ferry CHAMPION JET 1 sailed from the port of Santa Cruz de Tenerife, heading for the port of Las Palmas de Gran Canaria, with 62 passengers and an unknown number of private cars aboard. The vessel carried 36 crew and a company superintendent. The vessel ran the regular ferry route between Las Palmas and Santa Cruz, and this was the second daily round trip between these two ports.

The voyage was uneventful until 20:10, approaching Las Palmas, when the starboard SOME propulsion engine low fuel pressure alarm in the bridge went off. Seconds later, the CCTV showed flames in the engine affected. The captain ordered the fire dampers and fire doors to be closed. After checking that there was no-one in the starboard engine room, the fixed CO₂ fire extinguisher system was triggered and fire-fighting teams were enlisted. The fire was seen to be out, and the captain communicated the incident to the Las Palmas CCS.

At 20:24, the vessel CHAMPION JET 1 notified the Las Palmas CCS that they had suffered an outbreak of fire in a starboard propulsion engine, which was now under control, and that they required a tug to help them to enter the port and dock.

The Las Palmas CCS put the salvage vessel MIGUEL DE CERVANTES on stand-by, in case its intervention was required.

At 20:37, the pilot boarded the CHAMPION JET 1. The vessel entered the port assisted by the tug VB ADRIATICO.

At 21:18, the CHAMPION JET 1 informed that it had docked without problems.

The next day, after accessing the engine room affected, it was found that the fuel feed tube (a hollow bolt, or *banjo bolt*) of the fuel pump of cylinder A10 of the SOME had snapped off. The four studs attaching the fuel pump were also found to have snapped.

The main engine affected is made by RUSTON, model 20RK270, producing 7076kW (9621 HP) at 1,030 rpm.

3.2.1. Damage caused by the fire in the CHAMPION JET 1

There were no personal injuries, contamination nor damage other than to the vessel. The fire only affected the starboard engine room. Apart from the damage to the studs and the fuel line, the fire affected the following elements, components or systems:

- The electrical wiring of the engine.
- Fire detectors above the SOME.
- Thermal insulation on the exhaust of cylinder A10.
- A hole, with dimensions of 420x300mm, was found in the bilge, in a structural stringer.
- Several reinforcement beams between ribs 14.5 and 15 were bent.

The CHAMPION JET 1 was out of action for six days while the damage was repaired.

4. ANALYSIS

The accidents in the vessels VOLCAN DE TENO and CHAMPION JET 1 have a common origin: the breakage of several fuel-pump anchor studs on a propulsion engine of the same make and model, of practically equal power. The breakage of the studs holding the pump to the engine block allowed excessive vibration of the pump, leading to the fracture of the pump's fuel line, as a result of which, fuel was sprayed onto hot points on the engine itself, in both cases, cylinder-head purge valves that were not adequately covered or insulated.

In both cases the propulsion engine was a RUSTON model RK270, with 20 cylinders in a V configuration (also denominated 20RK270). The fuel pumps are held on by four studs.

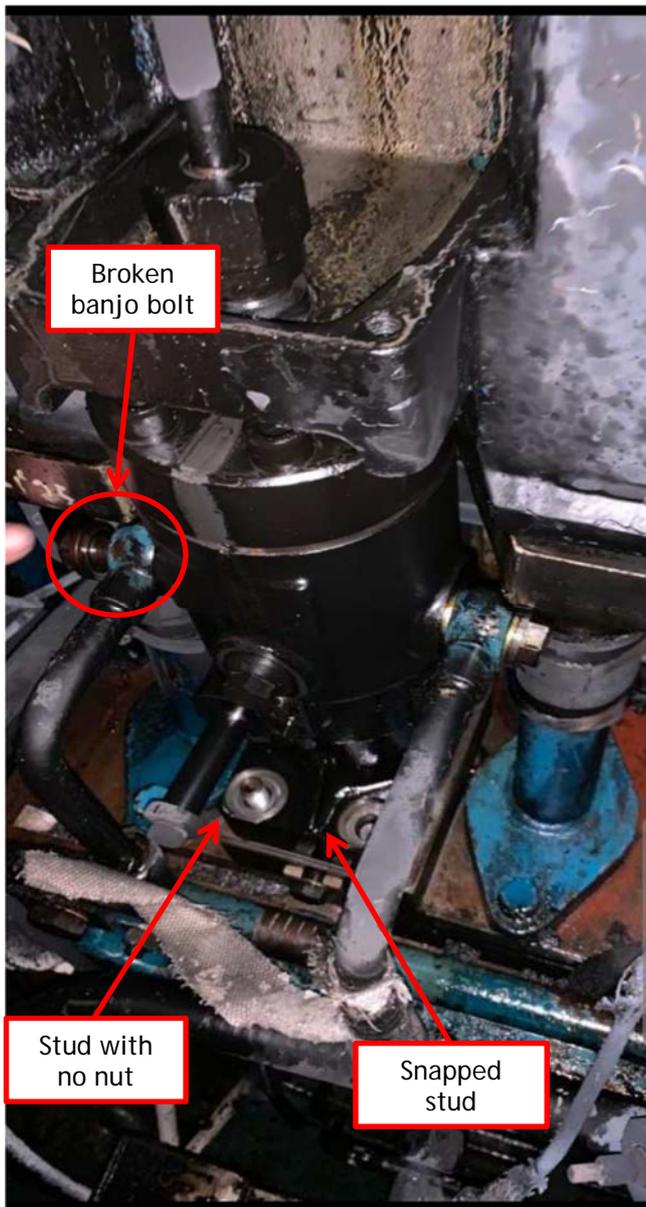


Figure 7. VOLCAN DE TENO fuel pump

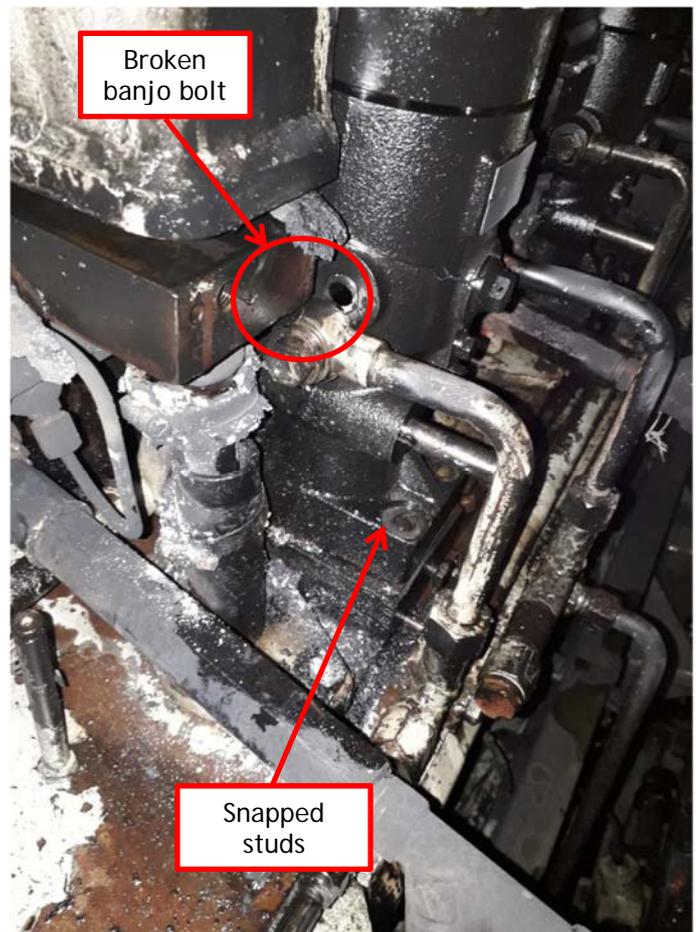


Figure 8. CHAMPION JET 1 fuel pump

4.1. Stud quality and tightening torque

The RUSTON company, which makes these engines, had issued a Service Bulletin in 1998 referring to the fuel pump anchor studs of model RK270 diesel engines, the type installed in both of these vessels.

This bulletin (see appendix II) was issued as a result of several incidents in which the fuel pump anchor studs had failed as a result of being improperly tightened. In this bulletin, a tightening torque of 110Nm was recommended. The bulletin also recommended replacing the four studs, with their washers and nuts, if a pump maintenance inspection found that the tightening torque of any of the studs was less than 90Nm. Finally, to provide a greater margin in cases of incorrect tightening, the manufacturer of the engine replaced the original studs with others made with higher-quality material and a laminated thread. These new studs are identified by having a "3" stamped into one end.

In the VOLCAN DE TENO, some of the broken studs were marked with the "3" corresponding to the new design (see Figure 10), while others did not. In the CHAMPION JET 1, the studs that snapped were not of the new design, and in addition to this, non-original studs were found, presumably having been replaced at some time before the operating company took over the operation of these vessels.

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4.2. Initial location of the fire

In both cases, the fire started when fuel was sprayed onto a cylinder-head purge valve.

After the fire in the VOLCAN DE TENO, the operating company stated that the cylinder-head purge valves, where it is presumed that the fire started, had been installed to measure maximum pressures for cylinder head maintenance work. In the CHAMPION JET 1, the fire also started on a cylinder-head purge valve, with no indication as to why these valves had been installed but not insulated.

After the second accident, the company ordered insulation for the purge valves, ordering them to be removed until the insulation could be installed, to avoid the presence of hot spots.

From the above, it is presumed that it was common practice in these vessels to navigate with the cylinder-head purge valves installed without insulation.

4.3. Actions taken by the operating company after the accidents

After the first accident, in the VOLCAN DE TENO, in May 2019, the company attributed the snapping of the studs to possible material fatigue and took the following measures:

- Progressively replace all of the fuel pump studs of the four main engines.
- Establish on-board instructions to:
 - o Not navigate with the cylinder-head purge valves installed. If they were strictly necessary, to cover them with an insulating blanket.
 - o To comply strictly with the manufacturer's tightening protocols when attaching the pumps to the engine block.

After the second fire, in the CHAMPION JET 1, in June 2019, the following specific measures were taken for this vessel:

- Check the tightening torque of all of the fuel injection pump studs of the four main engines. 24 studs were found to be loose or elongated. Their replacement was programmed with new studs supplied by the manufacturer.
- Thermal insulation was installed to protect the cylinder-head purge valves on the main engines.

In addition to the above, the operating company issued an informative report on this experience, intended for all vessels in its fleet with RUSTON RK270 engines. This document includes the conclusions of both investigations and establishes a series of preventive measures.

- Since there is no record of the type of studs installed, nor of the time they have been installed, all studs, washers and nuts are to be replaced by new original parts.
- An additional maintenance task has been created, consisting in monthly checking of the stud tightening torque. If any studs are found with a tightening torque below 90Nm, they are to be replaced by new ones, with new washers and nuts.
- The useful life of these studs has been defined as 5 years. After this time, each stud will be replaced with a new one.
- A maintenance task has been created that consists in taking a thermal image every year of the engine room with the main engines running, to detect possible hot spots.

4.4. Checking the tightening torque of the studs and engine maintenance.

Checking the tightening torque of the studs holding the fuel pumps to the engine block is not a routine maintenance task carried out by the on-board personnel. Normally, this check is carried out in specialised workshops according to a maintenance program established by the manufacturer of the engine.

The operating company does not have, in either of the two vessels, records regarding the installation or replacement of the fuel injection pump studs of the main engines.

The International Safety Code for High-Speed Craft (HSC Code) of the International Maritime Organisation (IMO), in chapter 19 (inspection and maintenance requirements), dictates the following:

"19.2.2. In the performance of maintenance tasks, due regard shall be paid to maintenance manuals, service bulletins acceptable to the Administration and to any additional instructions of the Administration in this respect

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19.2.3. All modifications shall be recorded and their safety aspects investigated. Where it could have any effect on safety, the modification, together with its installation, shall be to the satisfaction of the Administration.

19.2.7. Records of defects and their correction shall be maintained and those defects of recurrent nature, or those which adversely affect craft or personal safety, shall be reported to the Administration.”

Since the Service Bulletin regarding the studs was issued by the manufacturer of the engine in 1998 and the craft were constructed in the years 1997 and 2000, all of the pump anchor studs should have been replaced with the new design (studs stamped with a “3”) and tightened according to the procedure defined in said Service Bulletin.

The fact that only some of the studs were of the new design and that non-original studs were found, plus the lack of records of when they were replaced, indicates that the maintenance of the propulsion engines, during a large part of the operational life of both craft, did not comply with the stipulations of the International Code of Safety for High-Speed Craft.

5. CONCLUSIONS

The fires on board the high-speed passenger and wheeled vehicle ferries VOLCAN DE TENO and CHAMPION JET 1 both had the same cause: snapping of the fuel injection pump mounting studs on one of the RUSTON 20RK270 main engines. The loosening of the pump caused the fuel line to break at the pump inlet, spraying fuel onto a cylinder-head purge valve.

The end cause of the failure of the studs was improper management of engine maintenance.

The ignition of the fuel was possible because it sprayed onto a hot spot, due to incorrect operation of the engines by the crews on both craft, who navigated with purge valves installed in the cylinder head that were not properly insulated.

6. SAFETY RECOMMENDATIONS

In view of the actions taken by the operating company, no safety recommendations are proposed.

APPENDIX I. Photographs



Figure 9. VOLCAN DE TENO. Broken fuel line "banjo bolt"



Figure 10. VOLCAN DE TENO. One of the new-design studs, stamped with a "3"



Figure 11. VOLCAN DE TENO. One of the snapped studs

APPENDIX II Service Bulletin issued by the engine manufacturer



**SERVICE BULLETIN - RS36 REV 1
PAGE 1 OF 1**

ENGINES

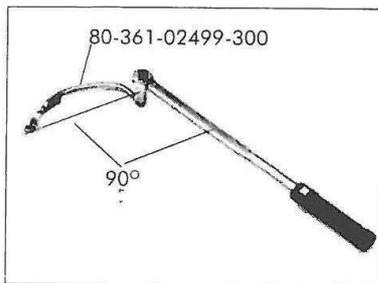
Ruston

This information is important to your service engineers and must be passed onto them immediately.

DATE: October 1998
SUBJECT: Fuel pump studs
APPLICATION: RK270 Mk2 engines

DESCRIPTION:

Fig 1.

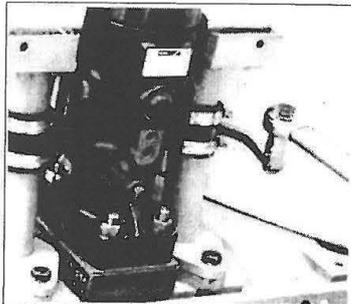


There have been a number of instances of fuel pump securing studs failing because these studs were not sufficiently tight. When this occurs there is a risk of fire from fuel leaking from damaged pipework.

It is recommended that the torque of all fuel pump studs is checked according to the following procedure.

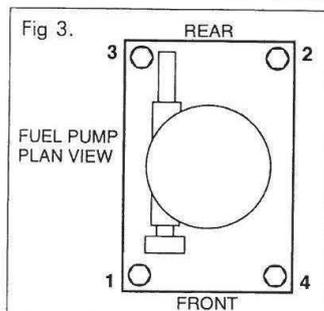
Fuel pump tool 80-361-02499-300 should be fitted to a suitably calibrated torque wrench and positioned with the ring end perpendicular to the wrench shaft, see Fig 1. Care should be taken to ensure that the angle of 90° is maintained throughout the tightening operation and to avoid touching the push rod tube immediately to the right of the fuel pump. Failure to do so will result in under or over tightening. The torque should be checked by 'cracking' or reading the wrench indicator and a torque of 110Nm (85 lb. ft.) should be found. Any fuel pumps found with torque on any studs less than 90Nm (70 lb. ft.) should be removed and all studs, washers and nuts replaced with new components. Removed parts should be returned, clearly labelled with engine serial number, cylinder number and hours run, to the factory for inspection.

Fig 2.



In order to provide further margin against incorrect tightening, a stronger fuel pump stud has been introduced of higher grade material and with rolled threads which should be fitted as soon as possible within the vessels/sites operating schedule. The stronger stud, 80-302-02329-302 is identified by the number '3' marked on the face of the 30mm threaded end. The studs should be secured in position in the crankcase with Loctite 221 and the stud threads should be lubricated with clean engine oil prior to fitting the fuel pump. Whenever a fuel pump is refitted, new nuts and flat washers **MUST** be employed to ensure the nut threads are undamaged. When replacing studs/nuts or refitting fuel pumps nuts should be 'nipped' in the sequence shown in Fig 3 to a torque of 60Nm (45lb ft.) and then finally tightened, in the same sequence, to a torque of 110Nm (85lb ft.).

Fig 3.



**SERIOUS ENGINE DAMAGE MAY BE CAUSED BY THE FITTING OF
NON-GENUINE SPARE PARTS - USE ONLY GENUINE RUSTON REPLACEMENT PARTS**

<p>MAN Diesel Ltd Training Course Notes</p>	<p>Engine RK270 Mk2</p>	<p>Page SB36</p>
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